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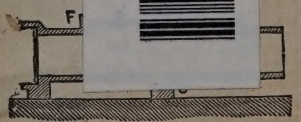

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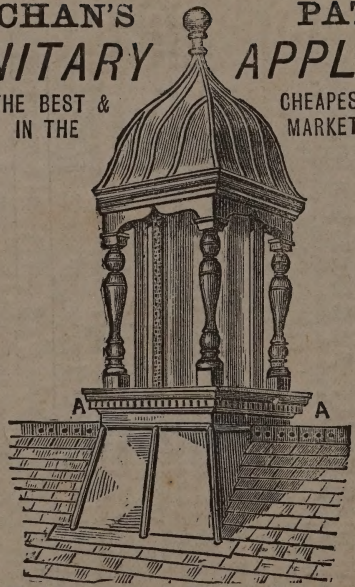

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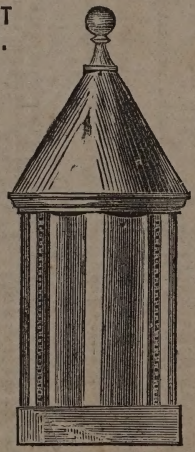

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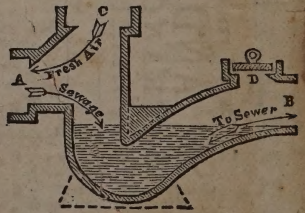

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PREFACE.

THE present Series of Lectures is the fourth that has been published by the Edinburgh Health Society. Before publication, these Lectures were, as in former years, delivered under the auspices of the Society to large audiences in Edinburgh on Saturday nights during the previous winter.

The Committee of the Society would again desire to place on record the deep sense of obligation they are under towards the Lecturers for their services to the Society, given in each case without any thought of remuneration.

The Committee would also respectfully invite Readers of this volume in Edinburgh and its vicinity, who approve of the objects of this Society, to kindly enrol themselves as Members. The larger its number of Members is, the more influential and capable of good work will the Society be.

Members are enrolled by the Honorary Secretary and Treasurer, or by the Publishers.

The THIRD ANNUAL REPORT of the Society will be found at the end of this Volume.

EDINBURGH
HEALTH SOCIETY.

INSTITUTED 1881.

PRESIDENT.

THE RIGHT HON. THE EARL OF ROSEBERY.

THIS SOCIETY has been formed:—

To promote, *by all means in its power*, attention to personal and domestic Cleanliness, to Comfort, Self-denial, Temperance, and the Laws of Health generally.

The means to be employed for this end may, in the opinion of the Committee, be stated in the meantime as follows:—

1. The delivery of Popular Lectures bearing on the subjects in question by Physicians and other qualified persons.
2. The printing and distribution of these Lectures, and of small Leaflets.
3. Providing subjects of Interest for the Mind, and encouraging proper Amusements and Physical Exercises.
4. Giving assistance to the Constituted Authorities in the promotion of sanitary improvements by drawing their special attention to any particular insanitary condition.
5. Obtaining the assistance, so far as necessary, of any other Society in the City willing to co-operate in the work of this Society.
6. Arranging for the *re*-delivery of the Society's Lectures in villages in the neighbourhood of Edinburgh, and for the formation in such places of small *local* Committees in connection with the Society.

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The Honorary Treasurer—COLIN M'CUAIG, Esq., C.A., 35 St Andrew Square.

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CIVIC SANITATION;

With Remarks on a City Ambulance.

By JOHN CHIENE, F.R.C.S.E.

My Lord Provost, Ladies, and Gentlemen,—

It is my privilege and my responsibility this evening to open the fourth session of one of the most important organisations in this city, the Health Society of Edinburgh. The programme of the lectures for the ensuing session has been published. Those who are to address you have chosen subjects of the highest interest. The syllabus speaks for itself, and requires no words of explanation or commendation from me. It would be presumptuous on my part to commend the lecturers: they are all well worth listening to; and I feel sure that, by regular attendance here on the Saturday evenings, you will learn much that will be useful, much that will enable you to lead healthier, and consequently happier lives. It will be my endeavour to-night to keep constantly before me the motto of your society; a motto written two hundred years ago: "*Thou that hast* Health (*says he*) *and know'st not how to prize it.—I'll teach thee what it is, that thou may'st love it better.*"—*Mainwayring*, A.D. 1683.

The special subject of lecture which I have chosen is, "A City Ambulance, or Speedy Aid to the Sick and Hurt." I cannot, however, forget that I open this session, and you will pardon me if, in the first instance, I say something to you regarding the scope of the Health Society of Edinburgh, and if I try and give you reasons for the existence of the Society.

The present age is one of enquiry, we are all taking less on trust, we wish to know the reason why anything is done, all knowledge is making great strides, no knowledge has made such advances as the science of sanitation. This Society is its child. Twenty years ago the public were beginning to recognise the great law that *public health means public wealth*, and as the result the Public Health Act of 1865 became law. In this Act certain extended powers were given to the Board of Supervision, which was first constituted in 1845. Local authorities were defined, and there was set in operation a number of laws and regulations having very important bearings on the health of the community.

During the last session of Parliament, Lord Advocate Balfour introduced an Act called the Burgh Police and Health Act for Scotland. The pressure of public business prevented this Act from becoming law. That Act will again be brought forward, and as members of the Health Society, it is your duty to take an interest in it, and to see that proper provisions are introduced which will make law those floating ideas which are the outcome of those advances which have been made in sanitary knowledge since the last Act was passed. Twenty years is a long time in this age of progress. These years have borne much fruit, which to a great extent is still ungathered. Take a deep interest in this question, and spend some of your political zeal in framing laws bearing on the preservation of your health.

The answer will be made to me—some of you are thinking of it now—that we have in our town a Municipal and Police Act, in which many sanitary clauses have been introduced; that this Act was passed as recently as 1879, and that, as far as Edinburgh is concerned, we require no Public Health Act. You surely are interested in the welfare of Scotland as a whole, and are not so foolish as to look on yourselves as entirely separate from your neighbours. You cannot pass by like the Levite of old. Do not most of you feel the necessity of a yearly holiday? You visit a health resort; do you always get health? Is it not notorious that you frequently contract diseases, the result of bad water, bad milk, bad drainage, and return to Edinburgh disgusted with your

vain and expensive endeavour to get renewed health for your daily work? This is one reason why you should take an interest in the general Act for Scotland. There is, however, another reason. The Municipal Act of 1879 is by no means perfect. Perfection is not of this world, and as citizens of no mean city, seize this opportunity to get various clauses in your own Act amended. If you lose this chance you may not have another for a quarter of a century.

I have not the time to discuss the Edinburgh Act fully; I almost wish I had, but it has been ordered otherwise. I gladly, however, avail myself, with your permission, of the great privilege afforded me as the person who has been chosen to open this session, and ask your consideration of some points in our Act which to my mind require alteration. I will in this way, I take it, best illustrate to you to-night the direction in which this Society can do good work.

The beauty of our city is dear to us, and of the utmost importance as bearing directly on our material prosperity. First, then, as regards the buildings that are now arising on every side, more especially on the outskirts of our city. Our esteemed Lord Provost, who takes so much interest in all questions connected with the amenity of Edinburgh, has lately told us that the rental of the city has increased nearly threefold, from £761,863 in 1854 to £1,893,696 in this year. The recent extension of the city boundaries has added house property assessed at upwards of £40,000. It is not the house property, however, on this new area to which I wish to direct your attention. I am not going to attempt to solve the difficult problem as to the best means to put new cloth into old garments; it is not an easy thing to remedy sanitary defects in old houses. Our public authorities are doing their best to remedy sanitary defects in houses; they are also endeavouring to close insanitary existing houses. We wish them all success in their difficult task.

It is on the ground that is still unfeued around our city that we must concentrate our thoughts at present. You see here a board with "ground to be feued," or a "building stance to feu." The proprietor desires to feu this ground; this is the

gentleman you have to deal with; his name is not on the board, but you can communicate with his law-agents. You are willing that he should get a fair profit, but you have to see that the feuing plan is so laid out that your interests are attended to. I am of opinion that a proprietor should not be allowed to cover to the very utmost his ground with tall, often ungainly tenements, which will soon be inhabited by a dense population, from whom, in a very few years, a clamour for recreation ground for air space, will arise. An open space is as necessary to a crowded locality as a lung is to a human body. This cry has already gone forth regarding the central parts of our city, and it has to be met *at your expense.* This you cannot help, but surely you are entitled to take some action with regard to the feuing plans which are now being laid out. If you do not see to it that every proprietor is bound by law to provide facilities for recreation ground, for air space, in a very few years the very same cry will arise from ground which is now open fields. Feuing plans are now being laid down, ground is being covered to the utmost limit of the law with buildings. Its utmost capacity is being utilised, as the phrase goes, by the speculator. I do not blame him. The future amenity of the district is not considered for a single moment. It is not his business; present profit, a large rental to him, a large feu-duty to the original proprietor, is the sole aim and object of those interested. As a result our city rental is rising rapidly; we are spending our air capital to attain this object. Is it altogether an unmixed good that it should be so? Are we doing what every sound public company does? Are we laying aside, so to speak, a reserve fund against the future? Are we not congratulating ourselves unduly on our increasing rental, our yearly profits, our present large interest, and forgetting the future when we will be called upon to spend our capital in purchasing air spaces for these crowded localities? From a paper by Dr Watt, on the statistics of the sick-rate of Friendly Societies in England, I gather that the sick-rate in our large towns (I do not necessarily include Edinburgh in this), is 36 per cent. in excess of the sick-rate in our rural districts.* To what is this tremen-

* If we adopt the sickness measure of the Friendly Societies, we shall end much work for sanitarians to do, in order to bring up large towns to

dous difference due? I answer, without hesitation, to the insufficient lung space in our towns.

I do not think that we should altogether selfishly overlook in this consideration the surrounding proprietors who have been content with a smaller return, and who have erected villas, and semi-detached houses, with garden ground and air space. Are the occupiers of these villas to have no consideration shown them? This, then, is an evil. You ask the remedy? *All feuing plans should pass through the hands of that most important committee, the Public Health Committee, before they are passed.*

Now, as regards the buildings themselves, they are under the control of the Dean of Guild Court. This Court is to my mind too much under the finger and thumb of the builders. We appoint builders to watch our builders. I for one would like to see fewer builders on it. Our Edinburgh houses are generally sound. Are they always as sanitary as they should be? Public opinion is now beginning to have its say on this matter, and builders are beginning to find out that many people are chary of occupying houses with distinct sanitary errors. As you are well aware, of late years building was overdone. Now, however, the demand is equal to the supply. A few years ago the demand exceeded the supply, and rows and blocks of houses were erected for the middle classes with all the sanitary water arrangements in the centre of the house. At any time a similar demand may arise, nay, will arise, if our Provost's anticipations with regard to the growth of the rental are correct; and this mischievous water centrality will again be the rule. Place the water closets in the centre of the house, carry necessarily the soil pipe down the centre of the

the position of the rural districts, where we know that except for out-door occupations, the means of health are not greater than in large towns; and we must not forget that a very considerable proportion of town members of Benefit Societies are also employed in out-door occupation. The average excess during the best years of life, say from twenty to fifty, is about 36·58 per cent., and seeing that members of Friendly Societies are a select class, we may safely conclude that the sickness of the outsiders, especially in large towns, is much greater. (Manchester Health Lectures, Series 1878-79, No. 7. "The Loss of Wealth by the Loss of Health," by John Watt, Ph.D.)

tenement, in its coffin of plaster, and the danger of sewer gas escaping from any leak is rendered doubly hazardous, because the imperfect joint cannot be easily discovered; *not to mention the difficulty of ventilating these darkened closets with borrowed lights.* The common stair is very often the common ventilating shaft; it often is itself central, and is very frequently itself unventilated. Such houses are now being erected for working men. *Our workmen are the mainstay* of the country. *Good health is necessary to good work.* The extension of our tramways, the opening of our suburban railway will open up large tracts of ground, our working classes will migrate to our outskirts. Let us see to the houses that are erected for their accommodation. A healthy home for the working man is one of the questions of the present day.

I would ask you to visit Craigmillar Castle if you wish to study the past wisdom of our architects 400 years ago. If you wish to know present opinion, look to Leeds, for example, on this matter. Let us not forget that Leeds is the town of one of our greatest sanitary reformers of the present day, and I am proud of the fact that Mr Teale is also one of the greatest authorities on surgery of the present day. Here is the Leeds bye-law: "Every person who shall construct a water closet in a building shall construct it in such a position that one of its sides at the least shall be an external wall. The window of the closet shall be at least 2 feet by 1 foot, exclusive of the frame, and opening directly into the external air." Specific laws are laid down with regard to an efficient constant system of ventilation of these closets. The Lord-Advocate says: "Every water closet shall be placed in such a position that one of its sides shall be an external wall, with a window therein, containing an area of at least 6 superficial feet, one half of which shall be made to open." No pigeonholes such as you will see in the court-yard of the building in which we are now met. But, gentlemen, you have not to go to Leeds; you have the very same law at your hand in Leith, thanks to the sagacity of a former Provost of the Burgh, Dr Henderson. Proprietors and builders did not like it, but he persevered and gained his point, all honour to him for it. It is a humiliating

fact—*Edinburgh has as yet no such law.* This is a disgrace to our fair city: this also is an evil, and must be amended.

Now as regards the height of our buildings, the tenement may, according to our Act, be one and a half times as high as the breadth of the street. In most English towns, in London for example, where surely land is as valuable as in Edinburgh, the tenement can only be in height equal to the breadth of the street. In the Lord Advocate's bill, the same sanitary standard is distinctly laid down. Sunlight is an essential to a healthy existence. We do our best to keep it out. In the London Act the new street must be 40 feet wide; in the Lord Advocate's bill, 36 feet wide; in the Edinburgh Act, 20 feet wide. I do not, however, lay stress on this remarkable lowering of the sanitary standard. The speculator does not avail himself of this permission, because a house 30 feet high is not enough to recoup him for the original heavy price paid for the land.

In the Lord Advocate's Act, "every building used as a dwelling house shall have directly attached thereto, in the rear of or at the side thereof, an open space *exclusively* belonging thereto, equal to at least *three-fourths* of the area to be occupied by the intended building." The Edinburgh Act says that "the open space shall be equal to at least *one half* of the area to be occupied by the intended house." Even this levelling down of the sanitary standard is not enough, because in the same clause we have the most unfortunate rider that in cases "where the thorough ventilation of such house is otherwise secured, or *under other special circumstances*," the said Dean of Guild Court, with its preponderance of builders, may allow the open space to be reduced in limits. These laws, lowering the sanitary standard, have a most baneful effect. A proprietor has a piece of ground; he desires very naturally to get the best price for it, we cannot blame him. He employs an architect, and that gentleman, *with our Municipal Act of* 1879 *as his standard*, makes a calculation, and a proportionate feu-duty is demanded. The speculator now steps in, and he makes a similar calculation, and trusting perchance to the help of his friends in the Dean of Guild Court, he hopes that his case may be one of those under "special circumstances." He takes

the ground and proceeds to build as near the law as he thinks the public will stand. Alter these laws, and the whole aspect of affairs is changed. Houses will be healthier, not dearer. The proprietor asks less, gets less, the speculator pays less, and he can therefore afford to spend money to make houses healthier.

Lastly, if I do not weary you, are those blocks of high dwelling-houses surrounding an air space, without any outlet whatever for bad air, inlet for good air, that are arising around us,—look at Dalry, Warrender Park, and along the side of the canal,—in accordance with common principles of sanitation? Our Act arranges for sufficient ingress and egress to and from our public buildings: does it also see to a sufficient circulation of air in these *air-wells*—or rather *airless wells*—which are arising on every side? *

I now take up our dairies and our milk shops. Milk is a sponge, and a dangerous sponge. It absorbs at once any deleterious matter, and is one of the most fertile causes of epidemics. In a paper by Mr Hart, read before the Health Department of the Social Science Congress in Glasgow, he analyses 53 outbreaks of typhoid fever, 17 of scarlet fever, and 12 of diphtheria due to milk. The milk epidemics in question had attacked in round numbers 3500 with typhoid, 880 with scarlet fever, and 700 with diphtheria. These cases have all occurred within the last twelve years. Mr Vacher in a paper says that nearly 100 epidemics have been traced to milk. The dairies and milk shops are well worth consideration. Our town dairies are inspected, and much good has recently been done by our energetic Officer of Health and his assistants. I cannot help thinking, however, that he would be thankful for more assistance. He should have under him an assistant medical officer to undertake this important duty. In the dairies in the town, that most excellent clause in

* I was informed after the lecture that there is a salutary law in force in Glasgow, whereby a method of ventilating these spaces is secured. In a block of buildings at Rosemount, Gardner's Crescent, ventilation to the enclosed air-space is obtained by open passages at the four corners. A more thorough way would be to have a complete opening at the four corners of every "airless well."—J. C.

our Municipal Act, referring to the registration of infectious diseases, enables the Medical Officer of Health to put his finger at once on any case of infectious disease occurring in a dairy within the burgh. Much of the milk, however, sold in Edinburgh comes from dairies outside the city: over them he has no such power. He may never be aware, until much mischief is done. We may have at any time a repetition of what occurred not so very long ago in the Morningside district. Dundee is at present suffering from two epidemics, one of scarlet fever, and one of typhoid, both originating from infected milk. The Lord Advocate desires to extend the same law with regard to the registration of infectious diseases to the whole of Scotland. Give him your individual assistance in this matter, and the result no doubt will be a stamping out of milk epidemics. They will be strangled at their very beginning. I have spoken of the necessity of attending to the sanitary standard of health resorts as one reason why you should take an interest in the Lord Advocate's Act; the rural dairies is surely another reason for your interest in this matter.

There is much room for improvement in our milk shops where milk is sold. No milk shop should have any connection with an inhabited house. There should be no possibility of sewer gas reaching the basins of milk. All milk shops should be licensed, as in Birmingham. Keep a sharp lookout on your milk cart, and see that it is not utilized for carrying pig's meat.

I have not time to speak of painters and servants being allowed to go outside windows to clean them without some protection. I have not time to speak of smoke nuisances. I have not time to speak of the importance of inspecting plumber work when building operations are going on. I have not time to speak of the importance of public baths and wash-houses. I have not time to speak of lodging houses. Common lodging houses, where a person pays fourpence a night, are well taken care of; what of the lodging houses of our students, clerks, shopmen, and shop-girls? All lodgings should, in my opinion, be periodically inspected and officially registered. This, no doubt, means money spent, but it would be money saved. Every case of fever treated

in the city hospital costs a considerable sum. From information supplied me by Mr Fasson of the Royal Infirmary, and Dr Wood, Resident Physician of the Fever Hospital, I find that on an average every case of scarlet fever admitted costs £8, 4s. 7d., and every case of typhoid fever costs £7, 1s. 6d. Every case that is prevented is money saved, and would fully compensate the town for the expense of inspection.

As regards infectious diseases, it is right to tell you that in Leith, ten years ago, Dr Henderson, to whom I have already referred, called on the medical men in the town, and with their hearty approval instituted an excellent plan for registering disease and preventing epidemics. Dr Littlejohn has taken a very great interest in this important matter, and he has now a most efficient system in full working order in Edinburgh. He has, like all reformers, had to bear considerable odium, and has been required to support his system against attacks, I am sorry to say, from medical men in many parts of England. He deserves our hearty approval and cordial co-operation. Dr Littlejohn has kindly supplied me with statistics, which enable me to show you the great amount of good work that is being done by his system of notification. It has been in force now for more than three years, and from it we learn that during the years of 1880-81-82, 15,913 cases of infectious diseases were intimated. Of these, 1258 cases were removed to hospital, and in those cases treated at home, any case was fully enquired into by the Medical Officer of Health, *when the medical man who intimated the case considered it necessary.*

I come now to the subject of my lecture. I hope I have not wearied you with these introductory remarks. The magistrates of the city have power to remove to an hospital any person labouring under infectious disease who cannot be properly isolated at his own home. They provide and maintain a carriage or carriages for this purpose, and pay the expenses of conveying the patients to the hospital. It is not my intention to-night to say anything further with reference to a city ambulance for the conveyance of patients suffering from an infectious disease. Further than that, it should be at once comfortable and cheerful, and non-funereal

in appearance. It is, however, my intention to bring under the notice of this influential meeting the importance of speedy aid to those who are hurt, and to those who are taken suddenly ill in our streets. At present in such cases such persons come under the care of sympathising bystanders or the police, none of whom have received any instruction whatever in what is now commonly known as "first aid to the sick or wounded." (Ambulance drill has recently been taught to some of the members of the volunteer corps of our town.) The person is placed either in a cab or on a police stretcher. I can imagine nothing worse adapted for the conveyance of a patient with a fractured limb than a cab. Endeavouring to get information upon this point, I asked the surgical porter (David Ramage) at the Royal Infirmary about it, when he said, "An open cab is bad enough, a closed cab is worse, but by far the worst of all is a hansom." There is difficulty in getting the injured person into the cab, there is difficulty in getting him out of the cab when he reaches the Infirmary or his own home. In the case of a fractured limb, the fracture may be changed from a simple to a compound one. The patient's stay in hospital will thereby be much prolonged, his chances of ultimate recovery greatly lessened, and his life endangered. In cases of persons suffering from faintness, as the result of heart disease, the sitting posture may make all the difference between life and death. In the case of the police-stretcher, the only advantage it has is the recumbent posture of the patient; in every other particular it is a most inefficient means of conveyance. The individual is exposed to the gaze of passers by. A crowd of boys follow the stretcher, the policemen who carry it convey the idea that the person is incapable from causes which cannot be classed as accidental, his progress through the streets is slow, and if he is wounded much blood may be lost, and he may arrive at the hospital, or his own home, in a most unsatisfactory condition. I have not overdrawn this picture. I have not been a surgeon in Edinburgh for twenty years without having seen cases that have suffered from all these evils, and I ask if the time has not come when we should try and find some remedy. In London,

the St John Ambulance Association has been in existence for seven years. In Glasgow, the St Andrew's Ambulance Association is now in full working order, and surely Edinburgh, with all its charitable organizations, with its important hospitals, with the largest medical school in Great Britain, should not be behind in this important matter. During the last three years an average of 720 cases of accident each year have been treated as in-patients in the Edinburgh Royal Infirmary ; many other cases have been taken there, their wounds and injuries dressed, and afterwards sent to their own homes. Many cases of accident are conveyed directly to their own homes ; many cases of sudden illness are conveyed in the imperfect manner to which I have referred, either to the hospital or their own homes, and I do not think that I am over-estimating it when I say that 1000 cases occur every year in Edinburgh which would benefit from a speedy and comfortable means of conveyance from the place of accident to the place of treatment.

I lately visited Glasgow with your honorary secretary, Mr W. A. Smith, in order that we might see for ourselves the working of this Association. We received every information and much courtesy from Mr W. M. Cunningham, the secretary, and from Drs Beatson and Whitson, who have from the first taken much interest in ambulance work. Let me rapidly sketch to you what the organization in Glasgow aims at.

The Glasgow Association undertakes two distinct pieces of work. First, they send lecturers to different districts of Glasgow, who give instruction to artizans and the citizens generally as to the best methods to relieve suffering, until either a medical man reaches the patient or the patient reaches a medical man. These lectures are termed "First Aid to the Injured." Systematic instruction is given, and any one who proves himself capable gets a certificate, stating that he is qualified to give first aid to the injured.

This certificate each man carries in his pocket, and shows by being the possessor of it that he is able to assist in cases of accident. He has been taught how to stop bleeding, how to treat with simple means a broken bone, how to lift a patient so as to do him no harm, how, in short, to make him as comfortable as pos-

sible in his unfortunate position. Many of these classes have been attended by the workmen at the public works, and there are now in Glasgow 131 certificated men (many others have some knowledge) spread all over the city, who can at once give efficient help in a case of accident. This help is appreciated, as you may have seen in the papers, that each member of the Ambulance Corps in attendance at the time of the Daphne disaster was presented with a handsome time-piece.

Second, when an accident has occurred a telegraphic or telephonic message is sent to 93 West Regent Street, the office of the Association, stating that an accident has occurred, and asking immediate assistance. There is close at hand a stable with a horse, and very shortly the horse ambulance is at the door (Mr Smith, your Secretary, timed it and found it to be six minutes). It is at once despatched, under the charge of a thoroughly trained attendant, to the scene of the accident. An ambulance box containing splints, bandages, &c., is kept at some of the large public works, so that temporary relief may be afforded before the arrival of the waggon. There are two of these ambulance waggons in Glasgow, and there is an attendant ready by day or by night at the Association Office, whose duty it is to accompany the ambulance, and render aid to the injured person during his conveyance to the hospital. The Association undertakes to send at once the Ambulance waggon to any accident within the burgh boundaries. During last year, the first year of the Society's existence, much good work was done by them.

No cases of infectious disease are carried, but patients are frequently carried from the hospital to their own homes; and during the hours when the principal works are closed, when accidents do not frequently occur, the ambulance waggons may be obtained to convey sick people to the railway station, or to places beyond the city boundaries, and at term time they are in much request in removing people who are unable to go in cabs to their new homes. I have satisfied myself on evidence that cannot be gainsaid (the daily papers speak highly of its value), that this Association is doing much good in Glasgow. I think Edinburgh is behind the age, and the time has arrived for the formation of a

similar Society, with a double function, *first*, to train the citizens in ambulance work, showing them how to give first aid to the injured, how to help their fellow-men who are suffering, and *second*, to supply a speedy, comfortable means of conveyance from the scene of the accident to the place of treatment.

I trust that the members of the Health Society will by their interest in this matter give the good cause a start: if it is once begun the system will go on. It has all the elements of success, because good is done by it. Edinburgh is not so large as Glasgow, and a horse ambulance might be a subject for future consideration after the Society became fairly organised, and a good start had been made. The Society in Edinburgh might begin with the lectures, train the citizens, educate the police and firemen, a matter of primary importance, and encourage the doctrine of the necessity for a more speedy and rational method of removal than we can at present boast of. Much good might be done by supplying each police station and each railway station with a litter, which is just a couple of wheels with india-rubber tyres, fitted on to a frame on which a stretcher with a light gauze covering can be placed. By this means all accidents would be speedily removed to hospital. Our authorities would allow them to pass along the pavements, and the injured person would arrive in a much better condition and with much less suffering than he does at present.

Mr Wilkins, our much respected fire-master, has arranged a litter by cheaply converting the old police-barrow. This conveyance is at the Police Office in High Street, and is chiefly used by persons under the influence of alcohol. I am glad to inform you that he is now occupied in making a light easy running litter. From his well-known ingenuity, we have every reason to hope for a most efficient machine. If one of these litters was placed at each of the police stations and fire stations, and if the post-office authorities would kindly put a red-cross on the post-office map at each of the points where a litter is kept, then in every case of sudden illness or accident it could be obtained, and the patient conveyed in half the time that he is at present to the place of treatment. Through the courtesy of Professor Annandale,

Chairman of the Committee of this Society, I have seen drawings of an excellent and commodious ambulance waggon now in use in Newcastle. It is suitable for either infectious diseases or accidents, and has been built under the superintendence of Dr Armstrong, Medical Officer of Health for Newcastle. It is made by Messrs Atkinson and Philipson, coach builders, of Newcastle. It has none of the funereal aspect so often seen in ambulance waggons used for carrying people suffering from infectious diseases to hospital.

I trust that I have said enough to encourage some one to take the matter up. I will give all the help I can. Mr Cunningham, the Secretary of the Glasgow Association, has the cause at heart, and I am sure that Mr Miller, one of the surgeons in the Edinburgh Infimary, and Dr P. A. Young, both of whom have already given Ambulance Lectures to volunteers in this city, would give their hearty help. Many of our junior practitioners and senior students would, I am sure, assist as lecturers, and we would soon have in Edinburgh a ready band of certificated assistants, who would give efficient first aid to any one who is injured, and would assist the police in removing them to the hospital or their own homes. It is wonderful the amount of latent sympathy in the world. I trust I have put the match to it to-night, and I hope soon to see an ambulance organisation worthy of this important city.*

In conclusion, there is no greater mistake than to suppose that lectures are the only object of this Society. It desires to do what it can towards the preservation of your health, and the lectures are only one means to that end. It exists with a larger object of endeavouring to form in this city and its neighbourhood a strong and healthy public opinion in favour of the observance of the

* At this point a demonstration on "speedy aid to the hurt" was gone through by five members of the audience, who had received a lesson in ambulance drill during the afternoon. The litter used was composed of a pair of tricycle wheels, two coach springs, and to each of these a piece of wood was attached; over this was fixed the stretcher. The supposed wounded person was promptly treated and lifted on to the stretcher. This stretcher is on view at Messrs Liddle & Johnston's (coach builders) showrooms, Grindlay Street, until December 1, 1883.—J. C.

sacred laws of health prescribed by God and man. The members believe that much of the social misery in existence, is due to the non-observance of these laws. With this end in view it desires to provide subjects of interest to the mind, and to encourage proper amusements and physical exercises. It desires to assist the constituted authorities in the promotion of sanitary improvements. With these objects in view, it desires that everyone present should become a member. By so doing, he will be directly assisting, by his influence and co-operation, the objects of this Society. If he holds aloof he will be retarding these objects, not by direct opposition which can be met, but by that most difficult of all oppositions—a careless indifference, which it is most difficult to meet. You will perhaps ask, What can I do? You under-estimate your power. Public opinion is the only efficient factor by which any change can be brought about. Indifference on the part of the public means failure; earnestness is certain success. Your town councillors and your members of Parliament are elected to carry out your wishes. Every public man is the servant of the public. When he finds that the majority, or even a powerful untiring minority, are in earnest about any thing, then that thing will be done. In electing your public men, let them understand that money spent in preventing disease is one of the most important and most economical things that they can do. Show them that disease means expense, that health means economy. Referring again to Dr Watt's lecture on the "Loss of Wealth by the loss of Health," he states:—"The experience of Friendly Societies, according to Mr Neison (1867), shows an average of about 2·45 weeks per annum per member for all ages between twenty-one and seventy years. But we have to include in our calculations the less prudent men, who are not members of Friendly Societies, and we may therefore safely assume an average sickness of 2½ working weeks per annum, and then we shall find that by loss of work through sickness the working men lose no less than £13,306,687 per annum; and if we add 25 per cent. to that sum for the losses of employers and dealers by lessened trade, we shall find a loss to society the measure of which is £16,633,359, or £1,108,890 for each day of sickness.

And for every day that we can lessen the average sickness of the heads of families in England and Wales, we shall add to the wealth of the country by more than a million sterling." Let them know that you are in earnest in preventing epidemics; that epidemics are preventable; that social misery can be lessened; that when epidemics get the mastery, then the expenditure is increased—directly, by money spent in combating the evil, indirectly, by keeping bread-winners from their work;—and enabling them by their wages to keep back poverty, to lessen the poor-rates and police rates, which exist in consequence of disease and misery, the direct result of breaking those laws which this Society inculcates. To-day, with an ordinary amount of sickness, and with no epidemics, we are directly paying away the yearly sum of over £40,000 in two diseases only—scarlet fever and typhoid fever. (See Appendix.) This, remember, is a calculation based on the number of cases that have been intimated to the Medical Officer of Health within the city boundaries during the past three years, during which time Edinburgh has been free from any marked epidemic. This sum is only the *primary* expense; it takes no account of secondary losses—inactivity during prolonged convalesence, of the results that frequently follow these diseases, of the loss to employers during the absence of the employees, of death and its immediate results, and of its incalculable secondary far-reaching results, when the heads of families have been removed, and their wives rendered widows, their children orphans. This is a sum equal to 5d. per £ on the city rental. It is ½d. in the £ more than we are paying for poor-rates. How anxiously do we watch for the reduction of our city taxes, how grudgingly do we pay ½d. in the £ more. Yet it is true that we are allowing ourselves to spend yearly an amount equal to 5d. in the £ on a sick rate in two diseases only, and we utter no complaint.

Educate a man to the evils of drink, and the drunkard ceases from our streets. Go into our hospital on a Saturday night, and observe the accidents; the great majority occur to those who are overcome by drink. Not only does the drunkard fill the hospital wards, but he fills the police cells, emptying in

the one case the pockets of the charitable, emptying in the other the pockets of the ratepayers. Surely this is a preventable evil. To take another example, spare no money in endeavouring to get a supply of pure milk. Let us also look to our schools; let us see that our children are not sitting beside members of an infected house. Place no obstacles in the way of the Corporation; encourage them to found hospitals for infectious diseases. I hope soon to see a well-regulated convalescent home for children and adults recovering from scarlet fever. Strengthen, by every means in your power, the hands of your Medical Officer of Health; assist him in every way you can in his endeavour to strangle and stamp out infectious diseases in their beginnings, welcome him when disease has come, and consult with him as to the best means of disinfection. Do not be misled, there is a great deal of foolish talk about the liberty of the subject, in this connection it is just another word for selfishness. It is a false liberty, which means slavery to your neighbour. Self-denial goes hand in hand with true liberty. By all means let us retain our liberty. It is unnecessary to tell a Scottish audience that our liberties are dear to us, but one man's selfish interests may be another man's poison, one man's liberty may be another man's hurt. A person is not at liberty to poison his neighbour's food. So also a man should not be allowed to injure or to give disease to his neighbours.

By those who are satisfied with our present condition, you will be told that our death rate is now very low. I grant this, but no one will deny that there is still much room for improvement. Surely this town, with all its natural advantages, is not going to take unhealthy towns as its standard. It must aim at being classed with the rural districts.

But further, *the death rate is not necessarily a criterion of the sick rate*, as the following figures, supplied me by Dr Littlejohn amply testify:—

	1880.	1881.	1882.
Typhus,	38·88 °/₀	60·86 °/₀	22·22 °/₀
Typhoid,	12·79 ,,	11·38 ,,	11·11 ,,
Diphtheria,	19·82 ,,	26·90 ,,	15·20 ,,
Measles,	5·97 ,,	3·18 ,,	2·12 ,,
Scarlet Fever,	16·65 ,,	13·18 ,,	4·26 ,,

Table shewing the per centage rate of deaths of those attacked.

Sickness means expense, anxiety, and discomfort. A time will come when all sicknesses are registered; the expense will be a flea-bite compared with the valuable lessons taught. *To meet an evil, we must know it thoroughly,*—where it lurks, whom it attacks, the sort of climate it prefers, &c. The relation of the science of meteorology to the sick rate has already received some attention from Dr Arthur Mitchell, and I think much good work can still be done in this direction.

This Society has another use, it desires to increase our general knowledge, which is daily becoming more and more necessary. There is at present, on the one hand, a tendency to centralisation: a central governing body in London is to manage everything. The experience of the last few years, however, is educating public opinion in an opposite direction. People are beginning to see that the Imperial Parliament has its hands full, and as an outcome of this belief, a reaction is taking place, and we will soon see a farther development in the direction of local government. Each community is anxious to manage its own affairs; people are beginning to take care of themselves. Smiles' "Self Help" is, I see, the favourite book in one of our public libraries. This is a good sign. Help yourselves, do not look to State aid; you are called upon individually through your Town Council, a body of hard working, well abused men—I, for one, have no sympathy whatever with the abuse—to take your share in the settlement of many questions which were formerly under State control, or unattended to altogether. There are many things that you will need to look to: one of the most important is the health of the community. In order to attend to these things, you must understand what is required; you must have a standard of sanitation, which it will be your individual duty to keep intact. This Society is a most powerful factor in this education. Let each one, every one present, join the Health Society of Edinburgh, and let him see that he takes his share in the education of the general community to a healthy public opinion, which has for its motto, PUBLIC HEALTH IS PUBLIC WEALTH.

APPENDIX.

(*a*) For every case of scarlet or typhoid fever admitted to hospital, each case of scarlet fever costs the hospital, ratepayers, and charitable public, on an average, £8, 4s. 7d. Each typhoid fever case costs £7, 1s. 6d. The average cost of these two for each person is £7, 13s. [On an average of the last three years, 296 persons were admitted yearly to hospital for one or other of these fevers; and 296 persons at £7, 13s., . =	£2,264	0	0
(*b*) Not treated in hospital, but on an average of cases reported to Medical Officer during the last three years, there were 2120 cases a-year treated at home. This, at the hospital rate of £7, 13s. for nursing, medicine, food, &c., =	16,218	0	0
(*c*) These 2120 persons must have had medical advice, and allowing for each person the sum of £5 for their account with the medical practitioner, . . . =	10,600	0	0
(*d*) Of 2120 persons sick at home, we may say that one-third of these are bread-winners, earning, let us say, £100 per annum. Allowing each person to be laid aside for two months, the loss =	11,777	0	0
(*e*) Of 296 persons sick with fever in hospital we may say that one-half are bread-winners, earning £50 per annum. These being laid aside from their labour for two months, . =	1,184	0	0
	£42,043	0	0

N.B.—In these calculations only typhoid and scarlet fever have been taken into consideration, and the yearly estimate of numbers is derived from statistics received from Dr Littlejohn during the past three years.

THE GROWTH AND DEVELOPMENT OF A CHILD IN BODY AND MIND.

By T. S. CLOUSTON, M.D.

The subject of the growth and development of a human being in body and mind from the period of birth up to maturity is one of the most interesting in the whole range of knowledge. Its practical importance is at least equal to its interest. To all classes of men and women it is a problem of vast importance. The student of mind, the student of body, the educationalist, the sociologist, the statesman, the clergyman, the brain worker, the craftsman—all should regard it as one about which we cannot know too much, and one in regard to which every increase of our knowledge necessarily tends towards human welfare and happiness. But beyond and above all these stands the parent, with an interest in the problem that is intensified by the keenest and tenderest of all human affections. What feeling is so keen as a mother's interest in her child's growth and gradual development? Has not every new fact in this process in the case of almost every child whose mother was there to see it, been observed and talked of ever since the world began? Was there ever any fact in a child's development too small for a mother's notice, or too unimportant to excite her interest? If all the observation of all the men of science since the beginning of creation on any subject that they have ever studied were measured, and if all the pleasure that that study has given were estimated, the sum would not amount to a millionth part of the attention and pleasure that the mothers of the world give and derive in one year from

watching their children grow in body and mind. The rapture of the man of science when he makes a new discovery is a tame feeling compared with the mother's joy when she sees her baby's first smile.

With this ceaseless observation, this vivid interest in the matter, it would be thought an impossible thing that our knowledge of the process and details of the mental and bodily growth of children should still have anything to be added to it, or should be lacking in fulness or precision. It might be thought that on this subject, at least, the instinctive power of observation of the parent, stimulated by such affection, would not need the trained mind of the man of science to help it in seeing the facts. A process that has gone on before the eyes of every parent during all time should have needed no elucidation from nineteenth century philosophers. All this abundance of opportunity might have been supposed to produce a glut of knowledge. Yet what are the facts? This most accessible field of study has been almost utterly neglected, at least till of late years. The fathers and mothers whose very lives have been bound up in the process of their children's development have been grossly inattentive to the ordinary facts, and blind beyond belief to their significance. The philosophers speculated about mind till they lost themselves in their own mental subtilities. Yet they failed to observe the gradual evolution of the minds of their children, where they would have seen mental facts more important than many of those obtained through their own introspection. The physiologists even were long content with studying the fully developed human being and neglected the process of his gradual growth. The teacher was mostly content with regarding children as mentally non-existent till they could learn and say their A B C. He classified their mental evolution thereafter by their capacity for reading, grammar, and languages; he commonly resented individual and hereditary peculiarities as the outcomes of original sin; and he often ignored the bodily development as a thing he had nothing to do with, and that had nothing to do with what he called "education" at all. The statesman till lately did not seem to concern

himself much with the making of a people. Nature was supposed to take entire charge of the development of men and women up to the ages when the schoolmaster and the policeman took them in charge; she making them into big and small, strong and weak, wise and foolish specimens, irrespective of human intervention, or the conditions under which they grew. Fortunately some of our statesmen have now arrived at a different mode of looking at the question.

The best way to realize our past inattention to the development of our children is to ask any intelligent educated father or mother or nurse, who have seen many children grow up, to tell you about how many pounds avoirdupois a healthy child should grow each year, and how many inches in height it should make each year till full growth is attained. These are very simple and easily ascertained facts, and most important ones. Yet how many times are they observed and noted? If the rate of body growth is not observed by the parent, how can any arrest of that growth be detected in time to remove its cause at once? My experience is that stoppages in the growth and proper development of children are usually not observed till they have gone too far to be easily remedied and their causes removed. If we ask this parent further the ages at which the faculties of memory and observation, or imitation, anger, and fear were first observed, and the time of life at which ideas of colour, form, and space are first developed, I fear we should get very unsatisfactory replies; or if we asked these same intelligent parents to give us some idea of the special mental and bodily characteristics of each alternate year of their children's lives from the first to the sixteenth, I should not be sanguine as to either the clearness or correctness of the answers. I should back an enthusiastic dog fancier to give a far more exact account of the development of a bull pup and his mental and bodily characteristics from his first months of life onwards.

With all this opportunity for parental observation during centuries, it was after all reserved for men of science to make the first careful and exact records of the mental and bodily development of children. Darwin, the greatest observer of nature and the profoundest intellect of the time, in the midst of his studies

of plants and animals, of the earth itself, and of their laws, did not neglect the study of his own children. In the year 1840 he began to make a minute series of observations on the mental development of one of his own children, from the first day of its birth onward, recording and interpreting the facts in his own matchlessly honest and simple way; and so little did he desire notice, that for thirty-seven years he allowed this record to lie by him unpublished, till the publication of a similar series of observations by M. Taine in France stimulated him to give to the world his narrative of "A Biographical Sketch of an Infant."* Since then many observers have entered this field, with very interesting and important results. These results, which will no doubt be added to every year, when taken along with such observations as Mr Galton is making into hereditary influences and family histories, cannot fail to be of use to mankind. The bodily growth and development of human beings has been more observed than the mental. Quetelet, as far back as 1830, studied the matter most elaborately; Bowditch, in the United States, made a careful series of useful observations in 1877; while among others in this country, Beddoe, Galton, and Roberts have worked, and are working at the matter.

It may therefore be a profitable thing for us to consider this great subject of a child's growth and development for the hour you have placed at my disposal, keeping more to principles than entering into details, and having more regard to the practical than the purely scientific aspects of the question. Indeed, the subject is so vast that it does not admit of a full treatment in the space of one lecture.

PRELIMINARY CONSIDERATIONS.

Now as a preliminary we must assume certain things about our child, as laws and influences that cause and govern its development, inasmuch as it is a bit of nature and subject to the laws that govern the development of all life in nature. In the first place we must take into account the facts of hereditary likeness. Every child will be like his ancestors, pretty nearly and in a

* *Mind*, July 1877.

general way. If they were Chinese, so will he be; if they were black, so will he be; if they took long in coming to maturity, so will he; if they were strong, so will he grow; if they were long lived, so will he have a chance of living; if they were good in a natural sense, the chances are he will be so too; if they were bad, he will have to struggle hard against his fate to turn out good. Like produces like all the world over. The more minutely the subject of "heredity," as it is conveniently called, is studied the more importance it assumes in determining the development of the bodies and minds of men and women. Down even to the minutest points we are finding that this is the cardinal and underlying fact. As we shall see, it may be influenced to some extent by conditions of life, by influences from the outside, by teaching and example, by public opinion, by the codes of morality and religion to which the individual is subjected, but none of these things will so change a man's innate tendencies and potentialities that if he has had a dull brain transmitted to him it will ever become an active one, or if his father and mother have been dwarfs he will become a giant. No doubt we are yet very far from knowing in detail the laws of the hereditary transmission of mental and bodily qualities. We cannot say why a man takes after his father or after his mother, or after any of his four grandparents or after some of his eight great-grandparents (not to go further back), or what gave him the special combination of the qualities of those fourteen nearest ancestors which he possesses. But the latest and most careful observations tend to show that from the moment of birth a man is under the dominion of his ancestry, deriving benefit from their virtues and suffering for their sins in a physiological sense. The latest researches show that from the very moment of birth hereditary influences come in down to the smallest matter, influencing how the body and mind develops and when their qualities appear. The very way the infant holds his bottle, his little tricks of motion and smiling, the time at which he can make out a colour, the way he is affected by a sound, all seem to be determined, not by chance or circumstance but by ancestral influences. The diseases he will be subject to, the germs of disease he will have the power to

resist, are no doubt determined in the same way. His body, his mind, nay his morals, from the beginning are not his own in any proper sense, but belong to his ancestry. From the moment of his birth, if we were only wise enough to read his horoscope, we would see certain qualities, certain tendencies, certain potentialities, certain issues, all as fixed and definite as the course of the sun. Any particular baby does not develop by chance therefore, but it contains within its brain and its body the general directions in which alone it will go, and the capacities it will be able to exercise. Just as newly born dogs' brains can only develop dog qualities, so a child's brain can only develop ancestral qualities in the main. The latter contains within it no doubt extraordinary capacities of development in different directions, and a marvellous store of future powers, not one of which are at birth apparent even in germ. They are potentialities in short, which must evolve into actual things in time and in degree according to fixed inherent laws. The general outcome of those potentialities and laws may no doubt be greatly modified by outward influences, but they cannot be essentially altered or repressed.

It is not to be forgotten that it is one of the laws of the hereditary transmission of qualities and powers from ancestry to posterity for acquired and accidental things to be so transmitted to a limited degree. A man by hard work as he grows to manhood creates big hands for himself, and having so acquired them he transmits big hands to his posterity to some extent, big-handedness getting more sure in all his descendants in each succeeding generation if they all work hard with their hands, and don't marry small-handed women.

The next great fact we must assume as affecting the development of a child, is that the brain is the dominant organ which rules the course of progress and determines all the great lines of development. The brain may be looked on practically as the child, all the other organs and members being subservient structures. I do not mean the brain in the popular restricted sense of the organ of mind, but in the actual and true sense of its being, the source of motion, of sensibility, of nutrition, and of animal heat as well as of the mental faculties.

The next great fact we must take into account looks like a contradiction of the first: it is the susceptibility of the brain and the body to be influenced in all directions but the principal ones that are inherent and hereditary, by outward conditions, physical and mental, by food, air, climate, exercise, example, teaching, sympathy, fear, emulation, sense of duty, power of self-control, morality and religion. It is one of the great problems yet unsolved to the full extent, just how far the influence of these extends, and how much they can affect the ancestral qualities.

The next thing we must take into account, is that the body and mind of every man and woman has strict limits beyond which it cannot be developed, and that every organ and every faculty have their limits of growth too. These limits are not the same for different individuals.

The next thing of importance we need to assume as being true in the development of a child, is that each organ of the body and each faculty of the mind bears such a relationship to the whole body and the whole mind, that if the growth of any one of them is unduly great, the growth of some or all the others will be proportionally restricted. The sum of the growth and activity in any one child is so far a fixed quantity that is divided into different streams of energy, one to the muscles, another to the bones, another to the heart, another to the motive part of the brain, another to the thinking part of the brain. If one of these streams is increased beyond its due proportion, the others are apt to run small or dry. If you try to develop the mind beyond its hereditary capacity, and unhappily succeed, it can only be at the expense of some bodily function, or of the length of life that was possible to that individual.

GROWTH AND DEVELOPMENT OF THE BODY.

Let us now pass to the actual facts in the growth and development of the body of a child. I can only, of course, glance hurriedly at the most important of them. At birth the average weight of a baby among a town population is $7\frac{1}{2}$ lbs., and its height $19\frac{1}{3}$ inches, girls being less than half an inch under boys.

It is then one-sixth of the height it will attain to. At that time it is the body and head of the infant that give the chief part of the height and weight, the limbs being, compared with the adult, disproportionately small and short. Every year till full maturity the arms and legs grow more in proportion than the head and body. A child grows more in height the first year than in any future year of its life, for its average growth is then $7\frac{3}{4}$ inches. If a man grew at that rate till he was twenty, he would be $14\frac{1}{2}$ feet tall! But during the second year the rate of growth is reduced to about half of this, being a little less than 4 inches, and the rate of growth becomes gradually less till the age of twelve, when it is reduced to about $1\frac{1}{2}$ or 2 inches a year, according to the health and social position and conditions of life of the child. After puberty there is an increased rate of growth in the non-labouring classes, and it stops at nineteen or twenty, while in the artisan classes the growth is more uniform, and extends to about the twenty-third year. The average height of girls is only just below that of boys up to thirteen years of age, when she beats him for a short time both in height and weight. After thirteen he strikes out in advance of her, and leaves her 4 inches below him at full maturity.

In the four years of babyhood, from birth to four, the growth should be about $19\frac{1}{2}$ inches in height, and 36 lbs. in weight; from five to nine a child should grow on an average 2 inches a year. It should gain about 9 lbs. from four to five, between 4 and 5 lbs. from five to six years, from 2 to 4 lbs. each year from six till twelve, when his weight should be 5 stone 4 lbs. and his height 4 feet 5 inches. He should then take a start and gain from 4 to 10 lbs. each year up to fifteen years, while he should be growing in that time exactly $2\frac{1}{2}$ inches a year, after the sort of stoppage of growth between nine and twelve, when he had only grown $1\frac{3}{4}$ inches a year. After fifteen he should grow nearly 3 inches in height, and gain over 10 lbs. in weight each year up till he is seventeen, after which the rate of growth in height and weight diminishes very fast. From seventeen to eighteen he grows less than 2 inches, and gains only 6 lbs.; from eighteen to nineteen $1\frac{1}{2}$ inch only is added to his stature, and 6 lbs. to his

weight; from nineteen to twenty, ¼ inch and 4 lbs., and after that he should only gain another ¼ inch in height and other 10 lbs. in weight.

For your convenience I give the average heights and weights of 14,000 boys and men of the artizan class living in large towns, after Dr Roberts,* from whom most of my figures as to body growth and weight are taken. At five years the height was 41 inches, and the weight (including clothes) 50 lbs.; at ten, 50½ inches, and 66 lbs; at fifteen, 60½ inches and 94 lbs.; and at twenty, 66¼ inches and 132 lbs.

But in considering the heights, weights, and progress of growth of children from such average, or from mean numbers, we must remember—1st, that vast numbers of individuals differ much from the average, apart from the effects of disease; 2d, that in many individuals the usual proportion of height to weight is departed from; and 3d, that very many individual children grow not according to the rates at the different ages I have given, but at quite different rates at the different ages, and are still healthy. Nature always practises variety in her operations, from the making of a simple crystal up to the making of a man. The difference between the tallest and the shortest boys at fourteen is 20 inches. I have taken the artisan class, as showing the least you should be satisfied with in the growth of your boys and girls.

The constant things which affect the growth and development of the human body are heredity, age, sex, and race; the chief of the secondary, temporary, and controllable things are occupation, disease, social habits, nurture, food, air, exercise, and rest. We all know in a general way that an old man loses height, but the scientific observations of Quetelet show that he begins to recede at fifty, and by the time he is ninety he has lost 1½ inch. The height woman attains is less than that of man, for three different reasons—1st, the woman is born a little smaller—about half an inch, as we have seen; 2d, she grows less each year after fourteen; and 3rd, her growth ends two years before that of man. Girls

* Roberts' *Manual of Anthropometry.*

have a spurt of rapid growth from eleven and a half to fifteen; in boys the same spurt only begins about twelve and a half or thirteen.

We all know in a general way that some races are bigger than others. We don't as yet know the fact from accurate statistics, but it is probable that this difference of size exists at birth. There is little doubt that a dozen Scotch babies would weigh far more than a dozen Chinese babies. And taking the races of which our own country is composed, Dr Beddoe has shown that early in boyhood the Teuton is bigger than the Celt, the Scotchman than the Englishman and the Irishman; while Dr Bowditch showed that native New England American boys grow faster than the children of the emigrants into the country.

It is proved beyond a doubt that social habits, food, and modes of life exercise a great influence on the rate of growth of children. Boys of the richer classes at the public schools in this country are on an average $3\frac{1}{2}$ inches taller and 10 lbs. heavier at twelve years of age than the sons of the industrial classes who have sedentary trades, such as shoemakers, tailors, or factory operatives. Comparing country and town simply, we find that the country has it in height and weight all along the line during boyhood and manhood.

Looking at the development of the different parts of the body, we find that they have a different relationship to each other, both as regards shape and size, at different ages. Taking first the legs, they are at birth very small, their average length being only $6\frac{1}{8}$ inches. They grow to five times that length, or $31\frac{1}{2}$ inches, at maturity. While the head and neck only double themselves from birth to maturity, the trunk increases to three times its length, and the arms to four times their length. But that growth is not uniform in any of the divisions of a limb. The thigh is that part of the body which increases at the greatest rate of any other portion, for this portion of the leg attains at maturity seven times its length at birth. It is the length of the thigh that determines to a greater extent than any other portion of the body the total height: about most tall persons we might truly say, not that they are a very great height, but that their

thighs are very long. Most likely their heads and bodies, and legs below the thighs are not very different from their shorter fellow-creatures. The arm doubles itself in length in the first four or five years. The trunk is the part that grows most regularly and equally in length and girth. In estimating the growth of a child, the chest girth is of great importance to note, for that shows roughly the breathing capacity. The average empty chest girth of newly-born children is $13\frac{1}{4}$ inches. It should have increased to $21\frac{1}{2}$ at five years of age, to 24 inches at ten, to $27\frac{1}{2}$ at fifteen, and to 31 inches at twenty, those numbers after birth (when all classes are about the same) applying to the artisan class in towns. From 2 to 4 inches must be added to those numbers for country boys or the sons of the richer classes.

The head is more completely developed at birth than any other part of the body. In the child it should be one-fourth, and in the adult it should be one-seventh part of the whole height in the average man and woman; but it is one-ninth in the case of giants, and one-fourth in the case of dwarfs. The foot is the part that from birth to maturity bears in length the same proportion to the whole height of the body. In the male sex the whole height should be $6\frac{3}{4}$ times the length of the foot; in the female sex, $6\frac{1}{4}$ times. At ten years of age the length of the foot should be exactly the height of the head.

Looking at the structure of the tissues and organs of the baby, we find they differ in many respects from that of the mature man or woman. Speaking generally, they are much more soft and unformed. The bones are each divided into many parts, and are largely composed of cartilage or gristle. They gradually harden until they become solid bone throughout at maturity. If they don't do so, we have them unfit to support the weight of the body, and they twist and bend as in the disease we call rickets. Being the platform on which the other tissues are raised, and forming the protecting case of the brain and internal organs, it is very important to have the bones grow and harden uniformly and fully. Yet they should not harden and unite in their different parts too soon. When that takes place among the bones of the skull the brain becomes cramped, cannot expand, and we have one variety of idiocy resulting.

The composition and structure of the muscles, of the internal organs, and of the blood are in some respects different in childhood from maturity. In all of these there is a gradual process of change and development as well as of growth after birth, which, if interfered with from disease or bad conditions of life, we have many evil results, so that fully developed and matured manhood and womanhood are not attained, and the bodily life of the individual is shortened, and his happiness interfered with, as well as the prospects of future generations marred.

GROWTH AND DEVELOPMENT OF THE BRAIN.

As we have seen, the brain is the dominant organ of the body from the moment of birth up to the time of death. We cannot study or understand in any way the growth or development of the body without reference to the brain, and above all we cannot study the mental development except through the brain. Granting that the infant has a mind apart from its body, yet it is quite certain if he could not see, or hear, or feel, or speak, his mind might grow, and we should have no knowledge whatever of the fact. But his mind would not grow in these circumstances. We must go to the mind apparatus, its organ, its originator, and revealer to us—the brain—when we want to study the mental development of a child. Where there is no brain there is no mind. Where the brain grows rightly, the mind develops naturally. Where the brain ceases to grow, the mind also ceases to develop, and we have idiocy resulting. If any of the organs of sense, such as the eye or ear, or their centres in the brain, are absent at birth, we cannot have full mental development. If a child is blind from birth, he cannot have the mental power of comparing one colour with another, and the whole of the ideas connected with colour are absent. You convey no idea to such a child by saying, "How nice the cool green of the grass is compared with the whiteness of the road," or by speaking of the "Red Republicans of 1790."

I am not going to describe the mechanism of the brain, but I must here refer to it as consisting of—1st. A receptive, regula-

tive and productive portion which appears to the naked eye as the convolutions (see fig. 1 C), and through the microscope when

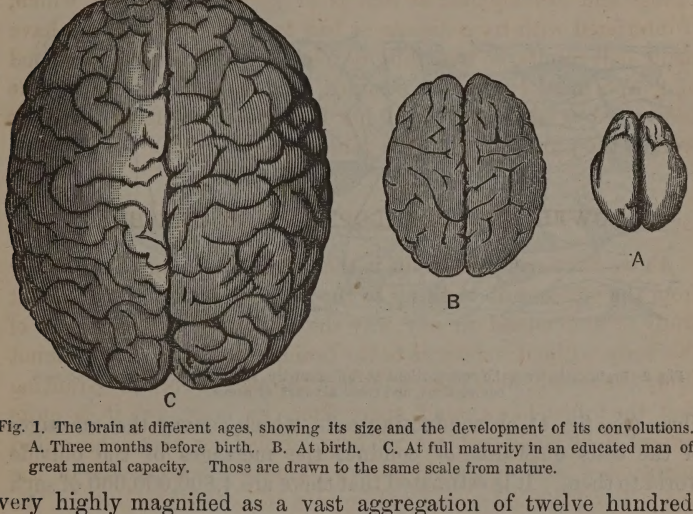

Fig. 1. The brain at different ages, showing its size and the development of its convolutions. A. Three months before birth. B. At birth. C. At full maturity in an educated man of great mental capacity. Those are drawn to the same scale from nature.

very highly magnified as a vast aggregation of twelve hundred millions of minute cells (fig. 2), each one of which acts by itself and also in combination with other cells in groups (see fig. 4), large and small. There are 1,200,000,000 of these cells. It is through the perfect action of these cells when fully developed, and of these groups of cells when properly grouped and associated with each other, that we have impressions properly received from the senses, and when received producing their proper feelings and ideas, and it is through them that we are able to send out energy to stimulate the muscles to move as we will. In fact, it is through these cells, their groupings and their activity, that we think and feel and move. A brain cell of the larger kind is a complicated and highly organised structure (see fig. 2), like an electric battery and telephone in one, with many processes projecting from it. The impressions from the outside would, through touch and the organs of sense, reach the cells through these processes just as the voice of the speaker at one end of a telephone

reaches the ear of the listener at the other end of it, by means of the current of electricity through the electric wire.

2. The second great portion of the brain consists of nerve

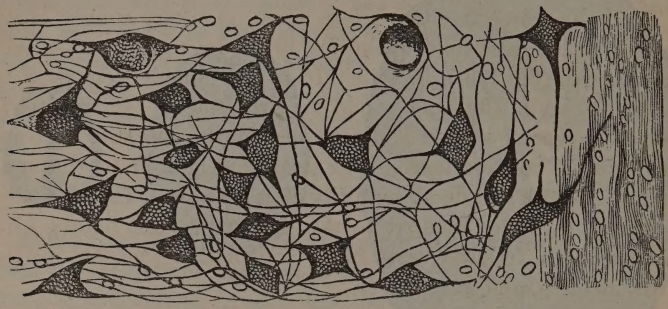

Fig. 2. Brain cells from the convolutions at full maturity, showing their forms, processes connections, and their network of fibres.

fibres (see fig. 4) or conducting rods, which convey the messages of the cells outwards, or conduct the messages of the outside world to them. It is estimated that there are 4,800,000,000 of such

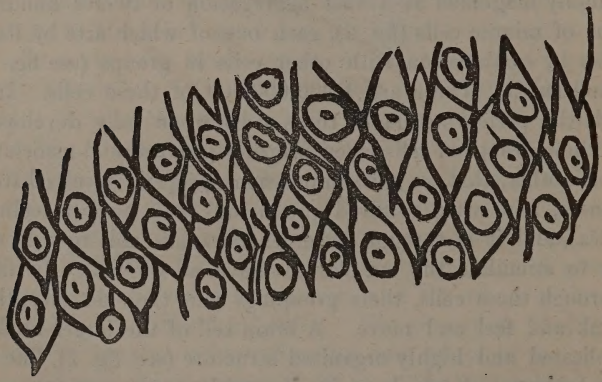

Fig. 3. Brain cells in their earliest and simplest stages before birth, before they have developed or connected themselves by processes, or formed themselves into groups.

fibres in the brain. Those numbers of cells and fibres in the fully developed brain are to us simply inconceivable, but the

statement of their number enables us in some degree to imagine the apparatus through which the infinite number of sensations, acquisitions, ideas, feelings, and remembrances of an adult educated man are possible.

The brain, three months before birth, is a very simple organ indeed, with almost no convolutions or foldings (fig. 1, A) at all, and at birth (fig. 1, B) its structure is still simple compared to the adult brain (fig. 1, C), and its size small. In a general way the power of a brain is determined by the number and complexity of its convolutions. The average weight of the brain at birth is 13.8 oz., while at maturity it is 49½ oz. The woodcuts A, B, and C, being reduced to the same scale from nature, give an idea of the relative sizes of the organ three months before birth, at birth, and at maturity.

It is in the intimate structure of the brain that this contrast between it in the early stages and at maturity comes out most strongly. As seen in Fig. 3, the brain cells in their very earliest

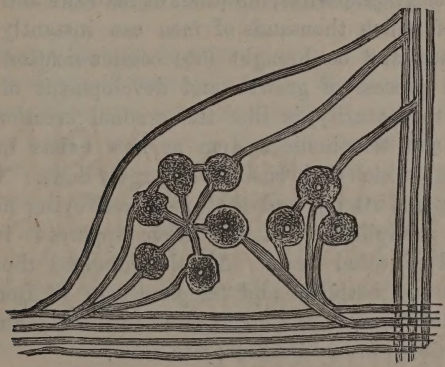

Fig. 4. A diagramatic representation of how brain cells associate themselves into specia groups, the cells in each group being specially connected with every other cell in it, and then the whole group with the general nervous system, through the fibres that pass in different directions.

condition are a mere series of simple bodies, with no connections or attached processes, and no special groupings, just like the cells composing the skin or the fat. The difference between this condition and that represented in Fig. 2, is very great

indeed, as regards development and capacity for high function. At maturity a bit of a convolution of the brain is the highest development of structure yet known in nature, and possesses by far the highest functions. It is so complicated and delicate, that it has yet defied the most skilful microscopists fully to unravel its structure. A section through it looks as confused as a section through a herring net might be, if you squeezed a portion of it up into a ball, dipped it in glue, allowed it to set, and then cut a slice through it. In its early stages it is so simple that a section through it more resembles a slice through an orange, where the divisions and seeds are seen at once to be symmetrical, and their arrangement simple. Now, this difference in structure is represented by a corresponding development in work, or capacity for work. At birth, the brain is like a simple telegraphic system in a small town, that brings the post-office, the merchant, the squire, and the doctor into communication with each other. At maturity, the brain is like a large city, with thousands of interlacing telegraphic wires, hundreds of batteries and telephones, by means of which thousands of men can instantly know each others' wishes, and be brought into communication with each other. The process of growth and development of the brain from birth to maturity, is like the gradual creation of such a telegraphic and telephonic system as now exists in our large cities, through which their business is largely done. The analogy fails at one point utterly, and that is in conveying an adequate idea of the complication of the nerve apparatus in the fully matured and educated brain. All the hundred thousand telegraph wires and batteries and telephones in all London, are a simple and intelligible system compared to the nervous apparatus of cells and fibres in one human brain.

The brain develops in a child by the multiplication of the cells and their processes and fibres, by the multiplication of the groupings of the cells, and by different groups being brought more and more into association with each other. The number of groups and associations of groups that can be made out of 1,200,000,000 cells, no mathematician could calculate, and no one can imagine. As Bain puts it: Suppose any human being has 50,000 mental acquisi-

tions of knowledge, there would be for each of these 20,000 cells and 100,000 fibres. With a total of 200,000 acquisitions, which would certainly include the most retentive and most richly endowed minds, there would be for each nervous grouping 5000 cells and 25,000 fibres. Brain development from birth consists in the perfecting of the apparatus for mental acquisition, and for corresponding mental expenditure.

To develop anything great and complicated in nature to perfection needs favourable conditions, and is always liable to many interferences. In fact, the risks are in proportion to the complication of the thing to be created. A simple lichen will grow on a bare rock exposed to any blast, while a delicate fruit tree needs soil and shelter, sunshine, and incessant care. The one runs no risk of arrest half-way, the other's life is full of risks, of death, of barrenness. We shall see by-and-bye the risks which the human brain runs in its development.

THE MENTAL DEVELOPMENT.

It may sound strange to some of you, but at birth a child is absolutely destitute of mental faculty. The thing does not exist. All competent observers agree on this point; and all newly born children are equally mindless. There is no exception. But why does the child cry, and seem to feel pain, and move, and feed himself? Those, at first, are all automatic or reflex actions unaccompanied by mind, the apparatus for performing which in the brain and spinal cord, is almost perfect at that time, while the mental apparatus is undeveloped. He breathes, too, as well as ever he will do, just because the group of nerve cells in the brain that produce and regulate the breathing movements is perfect at birth. He does not even see, as you can prove by holding a lighted candle before his eyes and moving it. He takes no notice of it, and he will not follow its movement with his eyes at all. About the ninth day he will stare at a candle, but it takes six or seven months before a child will follow an object with his eyes as if he really saw it. From the beginning he will start and cry at sounds, but that is automatic. It takes six months before he will give any

indication that he knows from what direction sounds proceed. He will grasp your finger if you tickle his palm at birth, but this is automatic. It takes him three months before he can first grasp anything voluntarily, and then with a co-ordinated movement puts it to his mouth. The movements of a child are, at first, vague and purposeless ; but when he finds that certain combined movements, such as putting things to his mouth, which at first he made accidentally, give him pleasure, he repeats them voluntarily again and again with more precision by practice till they are done with certainty. The apparatus for combining simple movements lies in the brain at first in a rudimentary form, but it is ready for development, and these movements, no doubt, help to develop the combinations of brain cells into groups, and to associate different groups with each other, while the pleasure the movements give, and their results, help to associate certain ideas with the movements each time they are repeated.

There is no doubt at all that the two first mental states that are developed in a child, the primary affections which precede all others, are a feeling of discomfort or ill-being when bodily or external conditions are out of harmony with his existence, and a feeling of well-being when they are favourable to him. Those feelings in some form exist no doubt in the lowest of the animal creation. In about three months it is evident that the exercise of his own powers of motion, when he tosses his arms and legs about, give him pleasure, and ever after during development, muscular exercise and pleasure go together. Hence motion is constantly practised. The sensation of pleasure is chiefly produced at first from without by the taking of food, and if the same person always gives it the pleasure is connected with an external cause, and so the feeling of attachment and love is first begun. A child first begins in a faint way to smile when he is about forty-five days old, and this is the first muscular expression of pleasure. Smiling commonly seems to arise in children at first from looking at their mothers. The sense of humour as evinced by smiling at anything of the nature of play, is not shown till about the age of three months. Pleasant surprise seems always to be the cause of the first sign of amuse-

ment. This capacity of humour and amusement becomes very strong in healthy children in a short time, and helps to make them play, and this again tends to develop their muscles, to keep their blood in active circulation, to increase their appetite, and so promote their bodily growth.

The development of speech, and the ways in which sounds and names are gradually associated with persons and things, and then with ideas, is one of the most interesting processes in a child's mental development. M. Taine studied this process carefully in his child. Of course a child can cry and make a noise from the moment of birth, but its language for long is "but a cry." The child first makes vowel sounds only. At three months many such sounds are made, and he goes on making sounds that have no apparent meaning to him. He is trying his vocal organs in a vague way, just like the purposeless though constant movements of his arms and legs. He must first learn to use his voice and make many sounds, and then he is able to select some out of these as a simple vocabulary for himself. Consonants are by degrees added to vowel sounds, and the exclamations become more and more articulate. Taine says the sounds (both vowels and consonants) "at first vague and difficult to catch, approached more and more nearly to those that we pronounce, and the series of simple cries came almost to resemble a foreign language that we could not understand. She takes delight in her twitter like a bird. She seems to smile with joy over it, but as yet it is only the twittering of a bird, for she attaches no meaning to the sounds she utters. She has learned only the materials of language at twelve months." As a child makes new sounds they amuse him, and he repeats them again and again. Education is at first only of use in calling attention to certain sounds that have already been found out and getting a meaning attached to them. All children say *papa* and *mamma* long before they attach any meaning to these words. It is certain the initiative for all this is in the brain. Imitation and curiosity are the great educative faculties of young children. From the fifth or sixth month children employ their whole time in making physical experiments. No animal shows the same interest in its own movements and sounds,

and in all things within its reach. At twelve months, all day long the child makes sounds, touches, feels, turns round, lets drop, tastes, and experiments upon everything he gets hold of, whatever it may be, ball, doll, coral, or plaything. When once it is sufficiently known it is thrown aside, there being nothing further to learn about it. Children attach meaning to the words heard before they can utter such words themselves, or before they attach meaning to the words they utter themselves. At first children make one word or sound cover a number of things. "*Bow-wow*" when first associated with a dog, usually means to the child not only all dogs, but all animals on four legs. Taine's little girl after having a picture of the infant Jesus pointed out to her repeatedly and called "baby," made that word stand for all pictures in bright shining frames, the frame in her mind being evidently the thing with which she associated the sound. The first few words she learned were attributive words or the names of things. Soon she invented a word, *tem*, which at first seemed to have no meaning for her; but she repeated it often and soon used it to express all the three ideas of *give*, *take*, and *look*. It was used to express a wish for anything, to direct attention to anything, and to order any object to be brought to her. This was a great advance in mental development over the mere knowing an object by a name. A dog could have done that, but a dog could not have used a sound to express this little girl's *tem*, nor have been made to understand the ideas it expressed in her case. The use of it at fifteen months old, marked the stage at which the human brain and mind proved itself superior to those of the most intelligent of the lower animals. After this she invented many such words for herself to express her own meaning, such as *ham* (eat, I want to eat). This power of inventing words to express meanings shows almost certainly that if two children were brought up by dumb parents and heard no speech, they would invent a language for themselves. The faculty of language is in their brains and would, as their brains develop, show itself independently of any imitation or teaching of any known speech. In fact, if a child's language is carefully studied from the first to the second year, we find that it has used several simple vocabu-

laries to express the same things at different stages of its speech-growth, and also that many meanings in succession are given to the same word; these meanings gradually becoming more specific and less general as its knowledge increases. Thus "*bow*" may be used to mean, to the child, all animals; then to mean any dog; and last of all to mean the special dog the child sees every day; and bye-and-bye it is discarded altogether for the real name of the dog when that can be pronounced. The same process essentially can be seen to have taken place in primitive peoples through a study of their languages. The aboriginal Australian has no words to distinguish darkness from a black colour.

Darwin tried to fix when and how the various mental feelings and powers arose. Fear is one of the first feelings that can be made out to arise in an infant. When a few weeks old he will begin to show signs of this by starting at any sudden sound, followed by crying. It is well known how older children suffer from vague and undefined fears from the dark, from passing obscure corners, &c. Darwin thinks such undefined but real feelings of dread are the inherited effects of the real dangers and abject superstitions of our savage ancestry transmitted to us.

Anger is exhibited after ten weeks, while violent passion is seen at four months by the flushed face and contorted features. Boys will bye-and-bye show their anger by throwing things at those who offend them; girls will show it by screaming and tearing at their clothes, showing how such things are inherited, and how soon such hereditary qualities are exhibited.

As to affection, it is very early shown, but there is no evidence that an infant can distinguish one person from another till it is four months old, notwithstanding the strong and delightful beliefs of all young mothers that their babies know them whenever they open their eyes. Sympathy is shown at six months old by a child's crying when its nurse cries. Jealousy is first seen about fifteen months of age.

So much for the simpler emotions. When does reason appear? Darwin says he observed the first proof of reasoning power on the 114th day in one of his children, when, "after grasping my finger and drawing it to his mouth, his own hand prevented

him from sucking it," and he showed his "practical reasoning" by "slipping his hand down my finger so as to get the end of it into his mouth." When 4½ months old he smiled at his image in the mirror, mistaking it for a real object; but in less than two months more he perfectly understood that it was an image, for if he was looking at his father's image and it grimaced, the child turned round and looked at the father. This could only have been done by a reasoning process. But he applied the same process when he saw his father through a plate glass window, for he looked behind him to see his real father, thinking it was another mirror and another image. Many associated ideas became fixed in his mind at five months, *e.g.*, going out, with putting on his hat, and at seven months he made the great stride of associating the nurse with her name. As Darwin remarks, What a contrast does the mind of an infant present to that of the pike, who during three whole months dashed and stunned himself against a glass partition, which separated him from some minnows, and when at last, after learning that he could not attack them with impunity, he was placed in the aquarium with these same minnows, then in a persistent and senseless manner he nearly starved himself by not attempting to eat them up.

The first sign of conscience, or a knowledge of right and wrong, was noticed by Darwin at the age of thirteen months, when his boy was made to look and feel unhappy by being accused of not giving his papa a kiss. A certain tendency to deceitfulness, and to do furtively what they have been told not to do and know to be wrong, is natural to most children, but it is developed in some to an enormously greater extent, and much sooner than in others. The children of the habitual criminal classes are said on all hands to take to deceit as a duck takes to water. The children of gipsies are restless, fawn, and lie just as naturally as their ancestors roved about and earned money by pretending to tell fortunes. The feeling of right and wrong can be strengthened greatly by proper means during the mental development. No doubt those means should be directed towards cultivating a love for the good, and a hatred and scorn for the evil, rather than towards merely causing a fear of bad consequences if the evil is

followed. In too sensitive children moral lessons can be too sedulously taught at too early an age, for I have seen by that means an artificial and false conscience created, so that right and wrong were seen in actions that had no moral meaning. I have seen a child of six brought to that pitch of unnatural morality that it felt acutely it was very wrong to eat too much jam to tea, cried, and was unhappy in consequence, and seriously contemplated the possibility of going to hell if it died that night. Any attempt to forestall nature in creating a conscience in a child is apt to be followed by a deadening of the sense of right and wrong in after life. The *knowing* of right from wrong should always in a child's mind be associated with the *doing* the one and avoiding the other, and the doing right should always be associated with those inward feelings of pleasure that well-doing should produce. Darwin says he educated his child in morals solely by working on his good feelings, and he soon became as truthful, open, and tender as anyone could desire, though at $2\frac{1}{2}$ he had shown "carefully planned deceit."

There are certain parts of the brain called the inhibitory or controlling portions which regulate the motions of the heart, of the lungs, and the nutrition of the body, as well as regulate and control the functions of other parts of the brain. They are higher parts that control the lower. It is of the greatest importance that those controlling portions are properly developed, just as it is of the highest importance that the great mental power of "self-control" should be properly developed. Some children will always, if untaught, allow their impulses and desires to run away with them, and will make no attempt to control their eating, or their play, or their desires to annoy or hurt their fellows. There is no doubt that the children of habitual drunkards and insane parents are apt to show this lack of the self-controlling faculty. It requires much careful study of each child's natural tendencies and inherited weaknesses to be able to guide its mental development rightly in this most important matter of self-control, but of all the lessons a child can learn, this is the most important.

The last power in a child, of which I shall speak in regard to its

development, is the general force of volition, or will-power to act and energize as an independent being, strongly and persistently. This, in a good brain, developes very rapidly after the first year, till past maturity. It is this which gives one man "force of character," as compared with another; that enables one man to persist in any course he has marked out for himself regardless of obstacles. It is this quality which makes one man great, as compared with another. All men must have it in some degree. It is most difficult to know how much a strong and persistent will should be repressed in a growing child, and how much it should be strengthened. There is a horrible expression one hears sometimes, that of "breaking a child's will." If it were possible to do such a thing, it would be the greatest injury that could be inflicted on any human being. It would be depriving him of his very highest faculty. Depend upon it, the stronger our children's wills are the better, so long as things go in the right direction. The best thing we can do is to develop the will-power of our children as much as possible, and to direct it aright. The more individuality and force of character they have the better.

There are certain faculties which are much stronger in children than in grown up people. Those are notably curiosity, imitation, keen desires, and a striving to make those about them laugh.

From birth, when the brain weighs about 14 oz., up to two years, when it has attained twice and a half that weight, there has been a series of new evolutions or creations of new faculties. After that there takes place a gradual perfecting of those faculties. From two years up to fourteen, the brain gains in weight from 34 up to 45 ounces, and the mental faculties and bodily powers should all be growing, developing, strengthening, and gaining in power, the memory laying up stores of acquired experience, the educability and imitation enabling the child to advance in some direction from everything it sees and hears. The comparing and judging power is ever strengthening and moulding the crude impressions and acquisitions into truer and more real knowledge.

The capacity of a child to take up any properly religious ideas comes later than its moral sense. Except in so far as religion is connected with right and wrong in action, its ideas are too abstract for an average child of two to understand them. It is doubtful if before the age of five, any sort of true idea of a Deity or a Creator can be acquired in most children. Looked at from the purely psychological point of view, those vague undefined fears to which I alluded are the foundation of the religious instinct. I need scarcely say to any rational man or woman how carefully we ought to develop those superstitious feelings of vague dread into something more elevating and ennobling, more rational and duty-inspiring.

As to the question of the period in the development of a child when he should go to school, I think it depends much on the sort of school he goes to, and the kind of child he is. Probably six would be the most suitable age to begin a systematic school education, from a medical point of a view of an average child's development.

I had intended to give a sort of analysis of a child's mental condition and powers at five and at ten years of age respectively, and of that of a youth at fifteen, comparing them with full maturity; but I have been so diffuse in saying what I have said, that I have left no time for myself to do this. The gradual development of the masculine and feminine special mental characteristics is also a subject of much interest that I must pass by.

SOME PRACTICAL CONSIDERATIONS CONNECTED WITH THE SUBJECT.

As this is a Health Lecture, I shall conclude by endeavouring to give some practical hints that may be useful to those who have the duty of supervising the growth and development of children, and who have the responsibility of endeavouring to attain the best result that is possible.

1. We should endeavour to find out the inherited peculiarities of mind and body of our children, so that during their growth and development weak points may be strengthened and strong

points may not be misunderstood. I am satisfied that we can't begin too early to do this. While evil tendencies of body or mind are "potentialities," as we say, or mere tendencies, something may be done to modify them; after they have become actual tangible things it is usually too late. If consumption, or convulsions, or rheumatism, or insanity, or heart disease, or lack of self-control, or immorality, or drunkenness have been strongly in the family, it is mere folly to think they may never appear in the children, and to neglect measures that during early life might help to correct those evil tendencies. It is better to look ahead in regard to these things. What better use can we make of our reason than this!

2. We should endeavour to promote proportionate development of all the faculties and powers bodily and mental, not attending to one set unduly in early life. In this we merely follow nature's lines. She resents forcing-house treatment of any faculty or power too early in life by dwarfing others. We should lay a good foundation for future special work, if that should be required, by promoting at first a sound mind in a sound body, that is well proportioned and stable mental and moral faculties in a healthy and vigorous frame.

3. Certain physical conditions are absolutely necessary to the proper growth and development of a child. Food should be abundant and simple. Milk, bread, butter, eggs, potatoes, vegetables, and Scotch broth are the very best of all foods for children, and they should be given in abundance, and often. Ask any stockbreeder how he feeds his calves when he wants to make them into prize cattle, and he will tell you that he saturates them with milk and lets them stand knee deep in rich grass all their babyhood. Flesh is neither necessary nor good for them in any but small quantity. Flesh-eating children are often nervous and thin, both of which are contrary to nature's type of child. Fresh air in abundance is absolutely necessary during development. The Queen's Park and the Meadows should save hundreds of children's lives in Edinburgh were they used as much as they should be.

Exercise and play are nature's best aids to proper develop-

ment. Play in a child means health, and makes health. Sleep in abundance is most necessary during development. In my opinion, a child can't sleep too long, especially one brought up in a city. But the minimum of sleep should be 12 hours a day up to four years, 11 hours from that to 7 years, 10½ from 7 to 10, 10 hours from that to 15, and 9 up to 20 years of age.

4. As we watch and guide children's development, we should never forget that great faculty of theirs, imitation, in which they exceed us by far. Nature develops it early in them as the chief means of their education. Let us show them a good example therefore, above all things.

5. We should weigh, measure, observe, and take stock of our growing children at regular intervals. It is a simple and most interesting process, and exceedingly important. I weigh my children the first Sunday in every month, and measure them every quarter. In that way we can often find out and stop the beginnings of evil.

SOME OF THE SPECIAL RISKS TO A CHILD DURING ITS GROWTH AND DEVELOPMENT.

1. The greatest of these are disease and death. During the first year of life, over one-fourth of all the deaths of this country take place, and very nearly one-half of all the deaths are those of children under five, or, to put it another way, one child in every six who are born dies in the first year of life, and one in every four within the first five years. If our care of them was what it should be, the little ones should not die at that rate. This is proved by the fact that while in Liverpool one child dies in its first year to every four and a half who are born, in the rural healthy county of Westmoreland only one dies to every nine and a half who are born. If the children throughout England had as good a chance of life as they have in Westmoreland, over 45,000 babies' lives would be spared. It is satisfactory that in Edinburgh we stand fairly well in this respect for a large city. The infants die with us at a less rate (127½ per 1000 births) than in any large English town, and we are considerably under all England,

town and county together (151 per 1000), in this respect. Nearly all the infectious and contagious diseases attack young children much more readily than grown people, and they are all then very fatal within the first year of life. No commentary that I can make would accentuate these figures. It is bad to be poor and to have to live in crowded streets, but the little children suffer above all.

2. If the development of the brain is arrested by disease or from any other cause, we have the condition of idiocy or mental imbecility resulting. One in every 700 of our population is in this condition, their number being over 30,000 in Great Britain.

3. Bad constitutions with the seeds of disease in them, unfit to stand the strain of life, or to do its work well, are commonly enough the result of improper or imperfect growth and development. The people whose lives are not worth having, frequently owe it to defects of care in their early years.

4. Wasted lives from mental and moral causes frequently have their origin in bad conditions of development. Lack of self-control is not surprising at maturity when the controlling faculty has not been developed in youth.

5. Over-development of faculty by unnatural forcing before the brain structure is developed is an unsafe proceeding, and may defeat its end entirely.

6. Lack of development and culture of the faculties from want of training and education leaves them useless, and the life stunted and unproductive in consequence.

In conclusion, let us not forget the truism that our children have their lives to live only once over, and if we can help them to make the best of their lives, they will assuredly in their maturity "arise up and call us blessed."

PHYSICAL EXERCISE; ITS USE AND ABUSE.

By CHARLES W. CATHCART, M.B., F.R.C.S.

Ladies and Gentlemen,—When I had the honour of addressing this Society last year on the subject of Physical Exercise, a wish was expressed at the close of the lecture that I should continue the subject in the series of Health Lectures for the present winter. I need not say that I felt honoured by the proposal, and having willingly acceded to it, I am here to-night to carry out your request to the best of my ability.

It was necessary last year to begin the subject under consideration from the beginning, and to understand precisely what physical exercise means, and what processes it really involves. We saw how important a place it holds in the economy of our frames, how it causes the bones to grow and the muscles to enlarge, how it quickens circulation, increases respiration, widens the chest, purifies the blood, and increases the tone and vigour of the whole system. In a word, I hope I succeeded in showing you that "physical exercise is of the greatest importance to mankind throughout life, and in young and growing people its value is simply beyond calculation." Working on now from this standpoint to the consideration of the actual applications of physical exercise to everyday life, we find ourselves face to face with a problem which is both difficult in its exact solution, and somewhat extensive in its bearings. The agent is undoubtedly a valuable one, but how we may use it to the best advantage at different ages and in the various conditions of life is a question which it is not so easy to settle. Accordingly it was with no little hesitation that I began the consideration of this branch of our subject. Not only was it difficult to select out of much that

might have been discussed, those special parts which it would be most advisable to consider, but when any part had been chosen, it seemed difficult to obtain evidence on it, to lay before you, which would be authentic and reliable. There seemed, however, to be one subject more under discussion than any other, and which we might therefore assume to be the more deserving of consideration, especially too since it seemed possible to obtain some reliable information about it. This was "the relation of school games to accidents," and so I resolved to make it the text or centre of my remarks to-night, leaving myself free to discuss any other bearings of the "use and abuse of physical exercise," as occasion and opportunity might suggest.

In some form or other we hear it constantly asked—"Is football not too dangerous?" "Does it need to be so rough?" "Can nothing be done to make it milder?" "Are athletics not overdone now-a-days?" These and similar questions must be familiar to most of us who have taken an interest in the subject, and so I thought it might be doing some service to the Society if I could in any way contribute to the solution of this important problem. In thinking over how we might best approach this subject, it occurred to me that the most natural source of information to appeal to would be the head-masters of the various schools throughout the country. These men being in constant charge of boys make it a duty to consider everything that may be for their welfare, and are therefore perhaps of all others the most justly entitled to be heard on such a subject as the present. With the object, then, of eliciting the views of these authorities (and of the school doctors where possible), and of thus being able to lay before you information that might be both interesting and fresh, I adopted the following plan. With the help of my friend, the Rev. Charles Darnell of Cargilfield, I drew up a series of questions which were sent to the various public and private schools throughout England and Scotland. The objects in view in framing the questions were to discover—(1) if the accidents at athletic exercises were really so serious as is often said to be the case; (2) if it were possible to avoid any of the supposed risks by making alterations in the method of carrying out the exercises and games; (3) if it were not true that boys left

to themselves without organised games were in greater danger of serious accidents than would be found to result from the game, even were all the worst fears realised ; (4) whether there was not good ground for believing that the exercises and games as at present carried on did not exercise a beneficial effect on even admittedly delicate lads ; (5) to discover if possible what class of delicate boys were benefited and what class were injured by being allowed to compete in athletic exercises ; (6) and lastly, to call forth the opinion of the head-master or school physician on any other point that he might think of importance in relation to the subject. You will perhaps be able to follow me better if I tell you precisely what the questions themselves were. The schedule headed "Athletic Exercises and School Games" left space for the name of the school, the average number of boys, and the period over which the observations were carried.

Question I. ran—"Have any serious accidents happened in the last years?" and in order to classify them space was left under the heads of "Fractures," "Dislocations and Sprains," and "Other Injuries," for accidents at the following:—"Football," "Cricket," "Athletic Sports," "Rowing," "Lawn Tennis," "Gymnastics, Single Stick, &c."; and "While Skylarking or Playing at no Organised Game." At the end of each there was room for the total and the number of boys playing in each, while below space was left for any remarks or notes that might be thought necessary.

II. If unable to give exact figures, can you say—(1) If any serious accidents have happened? (2) If they seem to you to have been more numerous in some games than in others, in proportion to the time occupied and the number engaged, or when no organised game was being played?

III. Is it your opinion that the athletic games and exercises as at present carried out involve such serious risk to life or limb as to call for or justify their modification?

IV. If so, can you suggest any such change in the carrying on of these sports or games as would lessen the risk?

V. Have you observed any evil consequences from chills or colds taken at or after games? or, on the other hand, from being spectators at games?

VI. Have you observed any evil consequences from these games not included in the above questions?

VII. Have you observed any change in the health of previously delicate boys which may be fairly attributed to athletic games or exercises?

VIII. Can you classify the admittedly delicate boys who have come under your notice as (1) those beneficially, (2) those injuriously affected by the exercises and games in question?

IX. Have you ever observed any immunity from epidemics among the boys who are specially engaged in athletic exercises?

X. Is there any other point which you think it important to mention in relation to this subject?

After each question a space for the answer was left, and with each schedule a printed letter was enclosed explaining the reasons for making the enquiry.

About eighty of these were sent out in all, and I have received altogether nearly forty replies. Some were merely to state that being day schools no returns could be given. Thirty gave answers more or less complete to the questions asked in the schedule, and a large number not only filled up the schedules, but sent me long letters besides. In one or two cases of the largest schools the medical attendants sent me in addition their opinion in the form of a short report. It was one of the stipulations of my letter that no names should be published, but I may, however, be allowed to say that among those who have answered are included the chief public and private schools in England and Scotland, and I should like to take this opportunity of thanking very heartily, although only in a general way, those who have so kindly aided me in this enquiry.

What I propose to do is to give you the chief replies to each of these questions, taken one by one, and then after indicating the general conclusions to which they point, to introduce any other aspects of the question which may seem to be of importance.

Statistics are proverbially untrustworthy, and I have no reason to ask you to believe that mine should be any exception to the rule. However, such as they are I lay them before you as the reply to our first question.

If we take football, which is without exception allowed to be the most productive of accidents, I find that altogether the records of 46 fractures (chiefly of the collar bone), 93 dislocations and sprains (some severe, some very trifling) and 23 other injuries are given to me. These have taken place among a total number of 3540 boys, in periods varying from 2 to 30 years. Reducing the original figures to single injuries per annum, we find that there would be one fracture among 760 players each year, and similarly one dislocation or sprain among 373, and one other injury among 1175 players. Putting all altogether there would be one recorded injury at football per annum or football season among 206 players. These certainly do not seem very serious. Allowing, however, for a given proportion of accidents to have escaped the memories of those who have recorded them, we may contrast with them the accidents given under the head of "Sky-larking," for a similar period at the same schools, bearing in mind that the chances of omissions are the same in both cases. The numbers respectively are 15 fractures, 47 sprains or dislocations, and 13 other injuries. These if reduced in the same way per annum give us one fracture among 2611, one dislocation or sprain among 1958, and one other injury among 2136 boys, or altogether one recorded injury while sky-larking among 740 boys each year. This, of course, is a considerable difference, but although it would be further increased if we considered that the latter extend over the whole school term, while football lasts only for four months, we must remember that one great purpose and function of football and other systematic exercises is to keep the boys from the inclination and opportunities for the risks of skylarking. If so many accidents happen when irregular play is kept down to a minimum, what would it be if boys were left to amuse themselves as they liked?

We need not calculate the accidents under the other headings, because altogether they do not amount to so many as from "sky-larking."

It would be unwise for us to base any conclusions on the numbers which I have just given to you; they are only intended to be indications, but it will be of interest to compare the results thus obtained from schools in different parts of the country,

with the general impressions of their various head-masters and school-doctors. These are, of course, all given as the result of individual experience, and without any of these writers being aware of the opinions expressed by the others.

Let me quote a few of the answers to Question II. From the head-master of a school of 300 comes: "Football is unquestionably the most dangerous school amusement, but the percentage of accidents with us is extremely small." A medical attendant says: "My experience extending over a period of upwards of thirty years, in a school of about, on an average, 600 boys and adults, shows conclusively, that while accidents are inevitable in so large a community living within a limited space, yet that the thorough regulation and enforcement of proper exercise tends to give security against some of the more severe forms of accident. During one period of the history of the school, when games and athletic exercise were under no kind of efficient regulation, serious accidents were of no rare occurrence." Again: "Of all games football exposes the player to the greatest risk of injury; the more rapid movement and closer contact of the bodies of the players in this game, of necessity increases the chance of injury. . . . . The gravity of injuries is greater in this than in any other game or sport." In a P.S. he adds: "Since the year 1849 none of the accidents that have happened in the school games have proved to be of life-long injury. Two boys who were very near to death in football are now strong men; one, I believe, is a missionary, the other in the army." A head-master says: "We have had several cases of fractured clavicle, and many sprains. They have always been the effect of football or gymnastics, chiefly the former. Regular games are not more liable to accident than casual practice." Again: "The worst mischief is done when no organised game is being played." Another says: "Accidents have generally occurred when by reason of the weather the boys were unable to play in the field." Another from a well-known school says: "Accidents seem to me more to be apprehended from confused hustling than when any regular game is played under strict rules." From one of the large English public schools comes the opinion of the head-master: "I believe they (athletic exercises, &c.) cause fewer accidents than would

arise if boys were to invent their separate forms of scrambling exercise. I think it is an exaggeration to suppose many accidents from games, even football." The medical attendant of 260 boys writes: "As a rule football is accompanied by more accidents than other games. We have had more severe injuries during sky-larking, &c., than during games, but accidents are more numerous during games." Again: "Quite as many sprains, bruises, cuts, from this source (sky-larking), as from all the organised games put together—none, however, very serious" (school of 500). From one of the largest of the public schools: "Football is the game which produces most accidents, but we have had very few of these." From the head-master of another, very nearly as large school, comes the following, which I think it better to quote to you at length: "The football accidents, though apparently numerous, are really trifling. On an average 500 boys play two games a week for ten weeks, giving a total of 10,000 games of individuals; the number of broken collar bones and arms may amount to two or three per annum. A broken leg or a serious brain concussion may occur once in ten years, *i.e.*, once in 100,000 games. Accidents to knees are most troublesome. There have been no accidents except one which I could consider really serious. This was a blow on the head, which was neglected, and it brought on serious inflammation, and required more than a year's rest."

These represent the general opinion, and coming from such important sources they are very valuable. They confirm the general results indicated by the previous rough statistics.

Having now ascertained that a certain proportion of accidents do occur, and that they are chiefly at football, and having further seen that unless some regular forms of exercise were employed the number and severity of accidents from irregular pranks and skylarking would be as great, if not greater, than from football, we have next to consider whether or not the risks might be lessened, and if so, how?

There is a considerable difference of opinion expressed in answer to Questions III. and IV. Some think no change need be thought of; some hold that the Association game is the safer; some that the Rugby form is, while others, the Rugby with

alterations. It will be more satisfactory if I again quote to you the actual replies which I have received, so that you may hear what is said for yourselves.

That there should be no change, comes the following:—"Certainly not. I did think it necessary to stop 'hacking' (*i.e.*, voluntary kicking) at football seven or eight years ago; and did stop it. They [the games, &c.] are all right as carried on at (——" one of the largest Rugby playing schools in England). From another larger school, playing the Association type of football, the head-master writes: "No. The risk is hardly appreciable in most cases," and as to a possible change, he says, "It is unnecessary." The same head-master whose statistical remarks I quoted at length says, in reference to the Rugby game: "I do not think that any alteration in the rules of the game would diminish its roughness. The abolition of hacking was very desirable, but is now accomplished." Another says: "Certainly not; we exempt boys from football on a doctor's certificate," and he sarcastically suggests for lessening the risks, "to wrap boys in cotton wool, and let them play with umbrellas and goloshes." Five simply say "no," or "certainly not," while others, although not thinking it desirable to make any alterations in the rules, offer certain suggestions as to the manner of playing, which might tend to minimise the risks. Such are: "Our experience leads to urge strongly that boys should be arranged for games in clubs according to size and age." Also: "I suggest for football, that it should be held to be bad policy to come into collision with any one, excepting at the ball, and bad play to kick anything but the ball." Another says: "Football may become quite unnecessarily rough. Boys ought constantly to be reminded that perfect control of temper is necessary, and that they should play like Christian gentlemen." While another writes: "The only modification that occurs to me is to insist on training. Those who are regularly taught gymnastics, and who run their mile daily, suffer very little from the violence of football, for they are always in good condition, and fall like cats."

The opinions in favour of the Association game are as follows:—One head-master from a Rugby playing school says: "Personally,

I should like all football to be Association, but then I was at Harrow. For young boys Association is best." One who has adopted the Association game for two years says: "Perhaps the Association rules for football are safer than Rugby." Another who has done the same says: "Football, as played under 'Rugby Union' rules (is) dangerous from the system of 'collaring,' so called, which gives very heavy falls." In reference to "collaring," another writes: "Forbid 'collaring' below the waist, and so return to the original game;" while in regard to "Rugby Union" rules, a head-master writes: "I think that football would be much less dangerous if a ball might not be picked up off the ground, or otherwise, than on first bound: holding a runner is the great danger of football." From another school playing the "Rugby Union" rules, the master writes: "I should always recommend Association rules. I think that the class of accidents are here less grave, as not including injuries to the *head*, and possible injuries to the spine, simple fractures are probably the least serious injuries."

Among those in favour of the Rugby form of the game may be included several who thought the existing rules should remain as they are. One gentleman after stating that in his experience very few serious accidents had occurred, continues, "I believe the reason is that we play here the Rugby game without hacking, which is in my opinion the safest form."

Some general remarks may here be of service. One master says: "Any football which permits tripping up, or hacking, or off-side play, or charging at any player except the player who has the ball (and at him only directly in front), is in my opinion extremely dangerous." . . . . "In football, which is very severe exercise, the dangers to be guarded against seem to be these: Over-exertion (exhaustion), over-excitement, leading to rough or unfair play and consequent injuries." The other head-master of the same Rugby playing school at which the last writer is a master says: "Even football, if the main object of the game is the ball, and no play is allowed excepting *at* the ball, has never been dangerous" (he is speaking of thirty years' experience). "It is easy to make it a brutal game, by allowing charging and kicking *not at the ball*, but it is perfectly unnecessary to do so," adding,

"I may observe that I have been a great player of games myself, and practiser of all manly sports, and understand what I talk about." Such remarks would of course be equally applicable to either form of game, and would imply that if these dangers were avoided the risks of injury would be diminished.

Sufficient has been said as to the risks from football. Before taking up the question of colds, we may briefly refer to some dangers in other forms of exercise. A head-master already quoted says: "The runs require most care, but we very rarely have any serious results from them." Paper chases are here referred to. As to running races, several think that the strain of a long race is likely to prove injurious, but only one gives any instance of this, and we may therefore suppose that, as Mr Morgan shewed by his researches into the after-health of the Inter-University boat crews, the real danger is often not so serious as it might appear. The opinion of one of large experience may, however, be quoted: ". . . . I should have more fear if rowing or gymnastics were to be largely introduced here, especially the former. I judge from my experience at Cambridge on this point. Rowing gives no pause to an exhausted boy, he must row on till the boat stops. At cricket and football pauses are frequent and are taken unconsciously; cases of exhaustion are almost unknown, though of great fatigue, common. In this respect also the racing of athletic sports, as mile races, &c., compare unfavourably with cricket and football." These are all that I have received, so we may now pass on to consider the risks from colds.

As might have been expected these risks are not inconsiderable. Most of the answers to the question allude to the dangers of sudden chill after exertion and over-heating, but a large proportion point to the greater risk run by those who are hanging about the ground as spectators of the matches and games. Many of these answers are important and suggestive, so I trust that you will allow me to quote again verbatim. "More colds caught from being mere spectators than from actually joining." "In my experience spectators suffer more from chills and colds than those taking part in the games." "Yes, from being spectators, either standing in damp grass for football, or lying down on grass to see cricket." Several more express precisely the same opinion. Another replies:

"Undoubtedly chills have been taken after football, both by players and spectators." Two have not only observed these results, but offer sugestions for avoiding them. One replies: "Of course, and therefore great care is taken to prevent boys as far as possible from lying down on grass, standing in rain without coats or umbrellas." The other says: "After games certainly, unless the rule of changing directly on getting home is enforced, but spectators at football are in greater danger than players. All our boy spectators at football have always either to play for twenty minutes after a match is over, or to run about a mile and a-half. Specta tors at cricket should not be allowed to lie on the grass except on a rug." A similar reply runs: "Chills occasionally occur to players from standing about after being heated by games. Not if flannels are worn, and changed directly after the games. Even in rainy weather I do not often trace illness to the game itself [cricket is worse than football here, owing to the standing about]. But to the *spectators*, the risk of cold is very great indeed. I consider that the looking on at football and athletic-sports is our most fertile source of coughs and colds, and the illnesses following upon them." Those schools who have not observed ill effects from chills among the players or spectators are in the minority among the replies, and I have thought it better to draw attention to this subject, so that precautions may be taken to avoid the risks from cold.

By the next question, *i.e.*, as to whether there was any additional bad result from athletics and not included in the previous queries, I wished to see if heart or lung injuries were ever found, as theoretically they have been supposed to be caused by these games and athletic exercises. It is somewhat striking, however, that in no case is there any allusion made to the heart or lungs as affected in the way indicated. Most have simply negatived the question, while the few who have entered into it have mentioned other points. Only one of these I shall now bring before your notice, as the rest belong to a later part of our lecture. This one is: "I think that constant scrimmages fostered by picking up at Rugby football strains a good many backs. The picking up was introduced by a number of thoughtless young men who cared only tor their own game. The ball should only be picked up on first round."

The two next questions, vii. and viii., may be taken together, as they both refer to the health of delicate boys, and were framed with the object of finding out what compensating advantages there might be in athletic exercises for the possible ill effects which it had been the main purpose of the previous questions to elicit. The first of them asked if *any* change had been observed in the health of boys previously supposed to be delicate; the second asked if there were any class of delicate boys whose health was improved and any whose health was injured by the sports and games. Very few have attempted to deal systematically with this last one, but a large majority have testified as to the improved strength and vigour under systematic exercise of boys who had come to school as indefinitely "delicate." Some of these are more guarded than others as to the chief cause of the improvement.

The medical attendant of a school of 600 boys says: "Delicate boys without positive disease almost invariably improve in health under the judicious use of gymnastics and games and athletics. A head-master who has studied the matter most carefully writes: "Often a great improvement, both in physical and moral health, never the opposite." Another with 250 boys under his care says: "I have had many delicate (not diseased) boys: invariably improve with the exercise of regular athletic games." The experience of one who has spent his life as boy and master at public schools is, that "speaking roughly from impressions, not statistics," 90 per cent. are benefited, 3 per cent. injured, and 7 per cent. are unchanged. Several replies similar to one another may be given consecutively. "Yes, great development of bone, change of weaklings into strong young men." "Yes, weakly boys become stronger, flabby boys more healthy." Again, "Very great benefit from both gymnastics and football. The change in delicate boys is often most marked, of course from their blood being better oxygenated, and their chest girth increased some inches." Also, "There are few boys so delicate that games do not do them good." And, "We have had many delicate boys whose improved health I attribute to the games."

Of the replies less distinct as to the cause of the improvement, I may quote the following: "It is difficult to say that one has

distinctly done so. I have known numbers of delicate boys who have greatly improved in health at school, but there are other causes which assist in this, so that one is careful in stating the matter too positively. My general *impression* is very decided that much good results to delicate boys from school games. I can state the converse proposition more decidedly. Many boys suffer in general health and elasticity who hang about or only indulge in desultory unorganised exercises." And another writes: "I have observed delicate boys who played games get strong and healthy, but I could not say it was directly attributable to the games." And others answer to the same effect.

The most frequent reply to Question VIII., the second of the two at present under discussion, is that no injury is known to have resulted to the health of a delicate boy, while many state at the same time that in cases of doubt boys are medically examined before being allowed to take part in the games and sports of the rest. Such a reply, which may be taken as a representative one, is the following from a school of 160 boys:—

"(1) I have never known a case during the time included in this statement (five years), where exercises and games did not act beneficially.

"(2) Boys are all examined by the medical officer and are not allowed to play when he forbids it. All play at some games, but about one per cent. are forbidden cricket and football."

The following are the answers where a classification has been attempted. From a medical attendant of a school of 260 boys: "Boys with sluggish circulation do well with sharp exercise. Boys with high spirits but rather weak bodies are liable to injure themselves." From a head-master who has paid much attention to the subject:—

"I. Boys beneficially affected are—1st, the large number not naturally delicate, but made so by coddling, and by a town life with too little exercise, and close hot rooms. 2d. Boys with consumptive or scrofulous tendencies.

"II. Those injuriously affected, if great care is not taken—

"1st. Boys with tendency to heart complaint.

"2d. ,, ,, ,, ,, rheumatism (from sudden chills)."

Another head-master gives as beneficially affected :—

"(*a*) Over-nervous boys—strengthened in mental fibre, cured of nervous habits, twitchings, &c.

"(*b*) Asthmatic subjects—relieved whenever they can play.

"(*c*) Weak circulations strengthened."

And as injuriously affected, "Boys above sixteen, with a tendency to weakness of heart."

These answers are, to say the least, suggestive, and they may serve as the basis for future observations for others who have not previously directed their attention to the subject.

The ninth question as to immunity from epidemics was asked, to see if the vigour of the athletic boys had been sufficient to enable them to throw off any tendency to disease which was affecting others around them. I have, however, only received one or two distinct replies to this question; in the other schedules, either there have been no epidemics at the school, or all the boys have been players, or where there have been epidemics no distinction between players and non-players has been observed. Several express opinions as to what would seem likely, but these being only theoretical I shall not quote them. One who has made observations on the matter says: "Boys who are in football training can hardly take scarlet fever. If they do take it (and I have only known one or two cases), it is so mild as only to be recognised by the rash. For this reason, if scarlet fever is about, football players need to be warned to look out for the rash. We had one dangerous case, evidently from the effects of unrecognised scarlet fever. There has not been the same immunity from measles." Against this another writes: "On the contrary, though I have often tried to do so, I have seen no connection between the two." Evidently it will be extremely difficult to collect evidence bearing strongly on the question; and so contenting ourselves with having had the question raised, we must now leave it in its present condition of uncertainty. This, however, we do with the less reluctance, since epidemics in schools are fortunately rare.

The discussion of this ninth question brings us to the end of those ones whose purpose was to deal with what may be called the physical effects of physical exercise, and its advantages and

disadvantages in this respect. The tenth and last question was framed to draw out opinions on any other bearings that the exercise might have on those who took part in them, whether from an intellectual or moral point of view. Several included their answers to this side of the question under Query No. VI., but as I meant this to refer to physical conditions, I did not discuss these replies along with the others, thinking it better to leave them till the present time. For the sake of convenience we may group the replies as they bear—1st, on the intellectual, 2d, on the moral aspect of the effects of physical exercise, and in each case we may again subdivide into advantages and disadvantages.

The possible intellectual disadvantages are such as the following :—"The temptation to spend too much time on them (games), and to think too much of athletic success;" this comes from one of the largest public schools in England. Another head-master says: "Boys are so excitable that very little work is done just before an interesting match." From one of the larger public schools comes: "The worst result of athletic sports is the tendency in young minds to worship mere skill in games without reference to moral or mental qualities. The balance, however, is less in danger than it used to be." A medical attendant of 260 boys writes: "After hard games (matches) the boys are not in a good condition for their school work for that day." A head-master of 140 boys has observed that "a certain number of boys show a diminution of intellectual power in the cricket season." Not many speak of direct intellectual gain, because this is much concerned with the *general* vigour and moral force gained by athletic exercises to be noticed immediately, but such remarks as the following may serve to indicate the feeling on the question, "The worst boys intellectually, physically, and morally, are the loafers." Or again, from one of very extensive experience: "The boys who work hard and play hard do not ape the vices of men, and are free from the insidious evils that often fasten on unoccupied boyhood."

If now we turn to the moral and educational aspect of athletic exercises the opinions are, I may say, altogether favourable and very strongly so. A good deal that is discussed need not be

entered into at the present time, but much of what remains you will be interested to hear; and as before, I think it better to give you the exact words of the writers:—"Nothing has a more healthy influence in promoting manly straightforward conduct amongst boys, than well-arranged athletic exercises, especially such a game as cricket." Again, from one who has been quoted before as of very large experience: "Athletics even in excess are better than the alternative, lounging for the idle, overwork for the studious. Athletics have most valuable results on character (*e.g.*, good temper, self-control, endurance, self-reliance) as well as on health." Another writes: "Positive advantages of such games," their influence "for pluck, for organization, for rapid judgment and action, for judgment of character, and a thousand more which are familiar to any schoolmaster who knows that his business is to make men." Again: "School games do great good in securing regular exercise for boys, and promoting habits of temperance and self-control: without them there would be a great deal of lounging, frequenting of pastry-cook shops and the like." Another says: "I have no doubt from the observation of games generally on boys at school, that they brighten the intellect, give a manly tone to the character, and are a useful safeguard against vice." While another writes: "It is plain that accidents, serious ones at times, result from football, but the beneficial results in strengthening the bodily powers, training the temper, cultivating courage and endurance, and presence of mind in face of danger, and generally producing a fine fearless disposition, make it the finest school game. Again: "In my opinion morality is greatly promoted by games, as well as health. They tend to straightforward conduct, also temperance of all kinds. They encourage self-sacrifice for the general good." These, I am sure, are sufficiently clear, and I need not therefore trouble you now with any further quotations. They may have seemed tedious to some of you, but they have enabled me to lay before you the opinions of those whose position and experience best enables them to judge, in regard to many very important questions in the "use and abuse of physical exercise."

Let us now sum up briefly what the evidence comes to in so far at least as our present enquiry has carried us. First, then,

we may learn that the masters and medical attendants of our large schools have for years been very carefully considering the question of physical exercise, and its bearing on the health of the pupils. This is very important, for in discussing this subject many do not sufficiently realise, and some neglect altogether, the weight that should be given to the opinion of Head-masters. Second, that although they have not thought it necessary to keep an exact record of every injury or accident that occurred, still their distinct opinion is that even in what are allowed to be the most dangerous forms of physical exercise, the risks to life or limb are comparatively trifling. Third, that while the majority do not think that any change in the method of carrying out our present games is to be desired, still a certain number see room for improvement in various directions, and we may take it for granted that all believe that they should be watched with care to prevent any dangerous innovations. Fourth, it seems undoubted that if regular and systematic games were not played at school, the accidents from pranks would probably outnumber those that occur under the present system of organised games. Fifth, that much care is required to guard against risk of cold for those who have been taking part in the games, and still more in the case of those who are merely spectators. Sixth, that a large proportion of the so-called "delicate" boys improve in health and vigour under the combined effects of simple food and regular exercise, and the other conditions of a healthy school life. Seventh and lastly, that the evils from idleness and want of occupation in school hours without games, and with them the gain in fostering manly virtues, in developing the character, and in strengthening the tone and fibre of the individuals, is so manifest as to be worth possible risk to a few, and fully to justify the rule in many schools that games are compulsory for all except those who can shew a medical certificate of incapacity.

So much, then, for the evidence of others, especially on the subject of exercise in schools. I will now, with your permission, add a few remarks of my own.

In the matter of accidents at football and other forms of

athletics, I may state that my personal experience fully bears out the general conclusions to which the opinions already quoted have led us. I played Rugby football at school and college in all for about twelve years, and not only incurred no serious accident myself, but do not recollect any having happened in my presence, except perhaps some not very severe sprains and one or two broken collar bones. For some time I was obliged to desist from playing on account of a strain to the muscles of the back, brought on probably by continuous "scrimmaging" in a very heavy match, and on this subject I shall have a word or two to say further on. The effects of this sprain have long ago disappeared, and in every way I believe my health to have been much improved by the game.

As some may not be aware of the points of difference between the two kinds of game, Rugby and Association, a few words in explanation may not be out of place. In the Rugby form the player is allowed to hold the ball and run with it towards his opponents' goal, while the other side may do their best to hold him, and take the ball out of his hands. In the Association game no one except the goal-keeper is allowed to handle the ball under any pretence, all management of the ball being done by the feet alone. From these points of difference many rules are framed, so that the character of each game comes to be considerably different, and the aspect of each to a spectator is quite distinct. In the Rugby game the arms, shoulders, and chest are much exercised in the efforts to throw off opponents while a player is running with the ball, or, on the contrary, while endeavouring to "collar" one who has already got it. Many tumbles are the result of these manœuvres, but they are more of wrestling fall than a complete throw, and are not nearly so heavy as they may at first seem. Tight scrimmages, too, are a feature of the Rugby game, and are the means of bringing the ball into play again after a player has been running with it and has been held. They consist of the forward players of each side wedging themselves together into a compact mass, and trying to push back their opponents, who are similarly arranged, the ball having previously been placed between them. After a few minutes' violent effort, one or other

side usually gives way or the ball gets loose, in which case the scrimmage breaks up, and the game goes on as before.

Under the Association rules, on the contrary, since the players are not allowed to use their hands or arms, there is no wrestling, and tight scrimmages are never formed. The consequence of this is that the game is much more open and free, the ball being always on the move, as it is passed from one player to another. But while the wrestling falls do not occur, what we may call complete throws are more common, for now, when a player wishes to upset an opponent when both are making for the ball, he must do it by a direct charge, or by a combination of charge and shoulder throw, which often results in heavy falls at full length. Another point to be borne in mind is that since the ball may not be handled, efforts are often made to kick it while it is still in the air, and this brings the foot of the kicker frequently into dangerous proximity with an opponent's body, should he be in the way. Fortunately, however, accidents from this cause do not often occur, although there is a risk of them.

Of the two games, the Rugby requires more strength in shoulders and arms, as well as in legs and back, while the Association requires more speed and activity, and greater neatness by managing the ball with the feet. The latter game has become extremely popular among the working classes of Scotland and the North of England, and has spread to a surprising degree within the last ten or twelve years. It is, perhaps, better suited to these players, since they do not so much require exercise of their upper limbs as of their lower ones, and since the rules, being comparatively simple, are more quickly picked up by lads who generally only begin to play after they have grown up. If, as is said, the accidents are less among grown-up lads in the Association game, this is another reason for its being played by those to whom a short time of work is a serious inroad into their means of livelihood. It is certainly a matter for congratulation that any game should have been found which attracts working lads to healthy open-air exercise on Saturday afternoons, and which draws out their friends in such numbers to watch them, as the Association game has been found to do.

As an exercise, the Rugby seems the better, since it developes

the upper part of the body as well as the lower, and, as a moral training, it seems also preferable, as there seems more scope for manly forbearance and good temper in its hearty rough-and-tumble struggles. The game might be improved, however, in a way calculated to lessen the risks of strain and crush, without taking away the good features by lessening the tight scrimmages as much as possible, and by encouraging a greater amount of "dribbling." One way to do this would be, as was suggested already, to allow running with the ball only from a "free catch" (*i.e.*, direct from the opponent's foot, before the ball has touched the ground), or on the first or second bound. The "forwards" at least might be thus restricted, and they should be enjoined not to avail themselves of even these privileges on all occasions, but to aim rather at concerted rushes in loose-scrimmage order; a plan of attack which is more effective than individual runs, even with good "chucking," while it is much more interesting to spectators. The objections to the tight scrimmages are that a very great deal of exertion is required with very little result; that any player getting on the ground might be seriously twisted or bruised by the wedged mass of his opponents surging over him, and that it forms a meaningless and uninteresting spectacle to lookers on.

A mode of holding an opponent by the neck and twisting his body on to the ground, known familiarly as "scragging," is strongly to be deprecated. It is not, at present, considered good play, but as there is no rule against it, the sooner it comes to be classed with deliberate hacking and expunged altogether, the better for the game. This is the more necessary when we remember that the great beauty and attraction of football is that it is, to a certain extent, rough and, within limits, even violent: otherwise it would not be the grand winter game that it is, available in all weathers, except in frost and snow, giving exercise, short, sharp, and bracing, and offering an indescribable charm and fascination to youths and young men "whose glory is in their strength" and who "rejoice as a strong man to run a race."

Now as to the dangers of football. What we have been speaking of to-night up to the present is the dangers of football as carried on at schools, and I hope I have been able to show you that here

the risk of serious accidents is really small, and much less than is generally supposed. Whence, then, comes the idea that football is so dangerous? A certain number of serious accidents do occur at football, but these are chiefly among the clubs of young men playing the game, and not among boys. There are several reasons why this should be. The men are heavier and stronger, but at the same time are not generally in such good condition, consequently being less firmly braced together, they are apt to fall more awkwardly, and are more fatigued by the exertion that is necessary. I have not been able to make particular enquiries so as to get more exact information, but I have referred to the serious and fatal accidents that have been published for some years past, and have found them almost invariably among young men, and chiefly among delicate ones working very hard in offices, who would have been better not to have played at all.

But even if we take the accidents at their worst, we find that they compare favourably with those at any of our other active out-door sports. In the hunting-field deaths are almost proverbially common, but does any one think of stopping fox-hunting on that account? In proportion to the numbers who annually ride after the hounds the risk to each one is comparatively trifling, and if we turn in the same way to football, out of the larger number of those who pursue the inflated leather case (and on their own legs), a very small proportion indeed are ever seriously injured. For an idea of the numbers, look even at last Monday's *Scotsman;* there were no less than 63 football matches, including those of schools, reported as having taken place this day last week, with probably as many again not dignified enough to appear in print, and I have no doubt there were as many to-day. Most of these were in and around Edinburgh itself, and I am certain that they do not represent half the number that were played in Scotland alone, and what number of players do they point to? Allowing, say 30 of them to be Rugby matches, with 15 a-side, or 30 players, and 33 of them to be Association, with 11 a-side, or 22 in the match, we have thus altogether 900 Rugby players and 726 Association, in all about 1600 players; and doubling this as an estimate, certainly much within the mark, for those playing in Scotland, we have a small army of 3200 football

players, stripped and ready for action, on Saturday week alone. When we hear of an accident in the football field, let us not forget out of how many this comes, and really what a small risk there is to each. But what of the advantage to the rest? Are you not now able to judge for yourselves how essential it is that lads and growing boys should have fresh vigorous exercise in the open air? Do we forget that football is strengthening their bones, expanding their chests, developing their muscles, and sending them out more manly vigorous men into the world to fight their battle of life? And if a very small minority suffer in the process, is it more than this world, with its mixture of good and evil, has ever brought us? If you ask why not minimise the evil, I reply by all means, and I would gladly do all I can to help, but don't let us lose sight of the advantages which we gain from the game. One thing above all others I would ask you to keep clearly in view, and that is, that unless the game afforded scope for strong and hearty exercise of muscle, it would be no attraction for strong and hearty young Britons. Until, therefore, we find a game which will give this scope to as great a number, and at in every way as small a cost of money, time, and limb, I trust it will long maintain the place which it now holds as our leading winter game.

But there are other forms of physical exercise to which I must very briefly allude, and one of these is athletics, meaning by that the various competitions in running and jumping. There, as elsewhere, it is difficult to lay down precise rules, but in races I would say there was a certain risk of boys over-exerting themselves. Overgrown lads, for instance, should be carefully watched, and in certain cases should be prevented from *competing* in races, although in the quieter preparatory practice for them a systematic and regular exercise is often afforded which is calculated to be of as great a service. Training properly carried out should never be omitted for a month or six weeks before a race, but it should consist of regular systematic practice, with sound wholesome diet, not the rigid dietary chiefly consisting of animal flesh which is a descendant of the empirical methods of our old prize-fighters, and the exhaustive physical work which some of our professional athletes think it necessary to insist on. As to diet, I can speak

from experience, and have found that the abstinence from fats of all kinds, as well as from potatoes and other sorts of starchy foods, is not only scientifically incorrect, but often produces a disorder of the system which materially interferes in the very objects which the training has had in view. Of course plenty of exercise and practice at the required distance must be taken, but this is not more than should be enjoyed by a healthy young man or boy whose life is regulated by physiological principles, not by the artificial requirements of the unwholesome side of our modern life.

As to golf, I hope many of you know what it is—one of the very best games that can be played at from boyhood up to old age. Time was when Bruntsfield Links give scope for a refreshing round for many of our jaded citizens, but now the traffic on and round that piece of ground has grown so much that the game is a source of pleasure no longer, either to those who play or to those who are passers by. If, then, the proposal to open up a Links on the Blackford Hills could by any means be carried out, it would be a very great gain to the city. One might easily dwell on the delights of golf, but our time is limited, and I must pass on.

As to lawn tennis, I need not detain you. It is one of the few games that can be played at by both sexes together. Admirable in its way, it is sometimes only too attractive, and harm has been done by its over use. From an hour and a half to two hours daily is probably as much as is good for any one, a caution which is especially necessary for some of our lady players. Men play in loose flannel, girls often in tight garments which are in every way unsuited for active exercise.

I shall not dilate on walking, more than to say this, that it is really the ground-work of all exercises, and should form part of the daily work of all. If this be the only available form of exercise, about two hours daily of sharp walking has been estimated as sufficient to keep an average man in good health; and it is as well to remember that with accelerated speed the exertion is called out in a rapidly increasing proportion. A pleasant companion in the walk is a very important item, and is just what makes the difference between an agreeable occupation and an irksome duty.

Riding, I must pass by with the single remark of commendation for all who can afford it; but on the subject of fives or hand-ball, I feel bound to ask your attention for a very few minutes. This is a game which is, unfortunately, only too much neglected, which is the more to be regretted since it is peculiarly adapted to the wants of those who live in towns. It only requires three walls and a limited space, needs no grass, and affords most bracing and exhilarating exercise in a short space of time.

The full-sized court in which it is played consists of a cemented or paved floor about 30 ft. long by 16 ft. broad, a back wall 16 ft. square, and two side walls beginning at 16 ft. high at the one end and gradually sinking to about 5 ft. at the other. This is meant for four players, but a much smaller one would do for two. A small, hard ball is used to play with, and the object is to strike the ball with the palm of the hand against the wall so that it bounds back on to the floor of the court for the opponents to strike in a similar way. By using the side walls the ball is made to pass through many angles before it reaches the ground, and in consequence its course is the more difficult to follow. Either hand is used equally, and thus the exercise has the great advantage of being uniform, and bringing both sides of the trunk and chest into action.

With little expense fives-courts might be erected in this and other large towns, and their presence would be the greatest boon to lads in shops and offices, who are in close confinement the most of the day. Such courts are much wanted, and if any one could be found enterprising enough to erect them on some spare yard or little-used area, and make a small charge for each game, he would find it a good investment for his money, while he would at the same time be conferring a benefit on his town.

In schools, where any of the boys are prevented by ill-health from joining in the football and cricket of their companions, fives has been found very valuable as a safe and efficient substitute.

I might easily dilate on the place and value of gymnastics, but our time does not admit of it. However, I will say this, that, as a general rule, gymnastics in a regular gymnasium should be undertaken systematically under an instructor's eye. If boys are turned loose into a gymnasium, they will probably do themselves

more harm than good: the exercise should be designed for the requirements of each, and should be steadily increased. These objections do not hold good for the series of exercises without apparatus generally known as the "Ling system." I have no experience of this personally, but I believe that it produces excellent results in developing the frame, and has been found of special service in the case of girls, delicate lads, and children. For most children a little of the Ling system may be a good thing, but what I would recommend most of all would be hearty romping play, as much as possible in the fresh breezes of the open air.

From one of the headmasters comes a suggestion which is too valuable to be omitted. He says, "Another point might almost have a lecture to itself, viz., the place of hard *useful* labour in education. Boys should be taught at school the use of carpenters' tools. They should learn to use the spade and wield the pick-axe. There is much useful 'navvy' work they might do both for school and for public objects. Such work strengthens their limbs, forms a relief from the monotony of regular games, gives a sense of the true dignity of manual labour, and is a blessing to those who may be farmers, colonists, or employers of labour. No one can judge well about any work who has not done it himself;" and in support of this sort of work he adds, "Every stroke of the pick-axe is a blow against our enemies the snob and the 'culchawed' prig."

As regards physical exercise for girls, I can only now make a few remarks, and those chiefly of a general character. It is becoming more clearly recognised than ever, that although they are of the same stamp and mould there are essential differences between the two sexes in their physical, moral, and intellectual natures. The same elements are, so to speak, present in each case, but being differently combined, the result is two natures with capacities different in degree although not in kind. It is by no means necessary to argue from this any inferiority on either side, but that there should be recognised a difference in all points with a main element of similarity is necessary to the point of view from which I wish to discuss our present subject. So far, then, as there is the main element of similarity in physical con-

stitution, is it equally necessary for girls as well as boys to have abundance of physical exercise, especially when they are young and growing, but so far as there are points of difference, the *kinds* of exercise must not be the same. The more violent games, such as football and hockey, and probably, for most, cricket, are neither suited to the tastes nor to the physical constitutions of girls, since their more sensitive natures seem to shrink from the roughness of hand-to-hand struggles, just as their more delicate frames are unsuited for the violence of them. Therefore we may at once leave out of consideration for girls those forms of rough and violent exercise which have been so strongly recommended for boys. Any attempts which have hitherto been made to introduce them among girls seem all to have failed, and it is only natural that they should.

But it would be just as great a mistake on the other side to suppose, as many seem to do, that because girls do not care for violent exercise, they should have little or none at all. A great deal of harm is being done daily to the health of hundreds of girls from neglect of proper exercise, and it is high time that the attention of parents and teachers be seriously turned to this question. To indicate in a general way the forms of exercise that may be selected, we may take such (so called romping) games as hide and seek, "I spy," &c.; also skipping ropes, and dancing for younger girls, and for older ones besides dancing (under healthy conditions), all the above, as long as their dignity will permit, which is, or should be, much longer than most think. Lawn tennis and similar games should be encouraged, as well as skating and plenty of sharp walking and climbing, *with an object in view.* There should also be a certain amount of calisthenic exercise, gymnastics, fencing, and work with light Indian clubs and dumb bells. Scarcely anything more inadequate could be conceived than the montonous "two and two" promenade of the typical girls' school; the evils of this are so manifest that I need surely not enlarge upon them. Again, just as certain kinds of manual labour may be recommended with advantage for boys, so certain other kinds may be urged for girls, *e.g.*, the milder forms of gardening, such as hoeing and raking, and a certain amount of domestic work, such as cooking, making beds, and dusting rooms,

if I may dare say so. The exercise of girls would require more care from those in charge than that of boys, to see in the first place that all do get a fair and regular amount of it, and in the second place to prevent some from taking too much. Often exercise for girls is brought into disrepute by the delicate and nervous ones over-straining their strength. It is just this keen nervous side of their nature, so sensitive and excitable, which exposes them to the risk of over-straining themselves mentally, and neglecting physical exercise altogether, that will lead them to take too much of it, if they are once strongly interested in it. A boy is not so easily moved, but with a comparatively small stimulus of competition or interest in mental or physical work a girl may be easily led to over-work, and do herself serious harm. Therefore, just in proportion as one would strongly urge physical exercise for girls to avoid the risks of over mental work in school, so one would caution against the risks of its over use as liable to bring into disfavour so excellent a cause.

Only one other point occurs to me as specially deserving our attention just now, and that is the *relation of brain work to exercise.* It must be in the experience of most men, that the fullest amount of brain work and of muscular exertion cannot be carried on simultaneously without injury to whoever is bold enough to try the experiment. Only a certain amount of nervous energy is available in the system. This may be expended either chiefly in muscle work or chiefly in brain work, or in a proportionate combination of both, but not in the fullest possible amount of each at the same time. Therefore when extra brain work is called for, we should not expect from our bodies the full amount of muscular exertion that they are capable of. Sufficient be it for the time if we get enough exercise to keep us in active health, and when we again have an opportunity, we can very soon bring our muscles up to their wonted standard. But since this preponderance of brain work in our modern life is so frequently unavoidable, it becomes all the more necessary that when the frame is still in its plastic condition, it should be stamped with the best possible physical impressions. The conditions necessary to attain this are not at all incompatible with sound mental training and earnest brain work, but it cannot go

along with that mental worry and labour which ought only to be found, if at all, among those who have reached maturity, and have passed into the active duties of life. A great deal of so-called "culture" and intellectual refinement may certainly be got out of some boys and growing lads, but don't let us be short-sighted as to what it may cost them. It may often be had, if you wish it, but consider first whether this or a vigorous active condition of mind and body are the most worth having, and we will then be able to regulate our means of training accordingly. To quote from Herbert Spencer, "the first requisite to success in life is 'to be a good animal,' and to be a nation of good animals is the first condition to national prosperity." If this be so, then it becomes us to see that whatever else we do we at least turn out our lads as strong and vigorous men when they start to their work among their fellows. I must, however, add a word of caution to those who in after life are unfortunately obliged to follow sedentary occupations. They should be careful how they return to their former activity. If caution be not used at first, the exercise will do more harm than good, so that it behoves us to be as careful as we can, always to begin gently and increase by degrees.

Had time permitted there are other branches of our subject which might have been considered, but we have already taken up enough, and of the possible ones, I think, the most important have been selected. You have heard the favourable opinion of physical exercise expressed by school-masters for boys in the middle and upper classes of life, and what is good for lads of one class will surely be good for those of another too. If I have succeeded in showing you that Physical Exercise is a good thing, and that it can be carried on especially by school-boys not only with little risk but with great gain as well, then I may feel that while my task is now ended, yours is only just about to begin. To you as to the Health Society of Edinburgh it only remains for me to hand over this important and responsible charge; that you do earnestly see to it, that before the city extends much further or many more years pass over our heads, there shall be for the poorer lads of our city a full and systematic provision for this great educational power, "Physical Exercise."

THE CHEMISTRY OF HEALTHY HOMES.

By Dr STEVENSON MACADAM, F.R.S.E.,
LECTURER ON CHEMISTRY, SURGEONS' HALL, EDINBURGH.

PART I.

In the rapid advance which Chemistry has made in recent years, there is no department which has progressed with greater strides than the application of the Science to the discovery and elucidation of these conditions and laws which subsist between man and other animals, and the outer world, comprehended under the general title of Sanitary Chemistry.

It is now an admitted fact that the air we breathe, the water we drink, and the solid food we partake of, considered along with other conditions surrounding us, such as drainage, sewerage, and scavenging, have an important bearing upon the health of communities and of individuals. That when air is contaminated in towns, houses, and rooms by overcrowding, or by gaseous exhalations rising from deposits of organic matters, and from common sewers; or water is polluted in wells, cisterns, or vessels, by sewage matters and other noxious substances; or food in the ordinary sense is tainted by putrefaction or disease, then surely the health of the neighbourhood suffers. Whilst, when reasonable care is taken to prevent the overcrowding of districts, houses, and rooms, and for the ventilation of such, and precautions are adopted for the supply of wholesome, uncontaminated water, as well as for the aeration of drains and sewers, then the health of the locality becomes improved.

In the elucidation of the causes or conditions of sanitation, Chemistry has taken the foremost part. No doubt other branches of Science have done their work in the isolation and identification

of the germs and organisms which are specially concerned therein, but Chemistry must explain those atmospheric and other conditions which are concerned with the growth and sustenance—the development and propagation—of those germs and organisms.

Statistics now plainly prove the value of sanitary measures. The death rate and sick rate of many towns have been lessened or reduced in proportion as sanitary works have been carried out. Such health measures have consisted in the avoidance of overcrowding, the opening up of air spaces in towns, which are the lungs of a populous place, the systematic removal of house garbage and fulzie, the improvement of the water supply, alike as to quantity as well as quality, and the introduction of modern drainage and sewerage properly ventilated. These measures have succeeded in many cases in warding off fevers and other ailments, and in reducing the mortality from 28 to 21 per 1000 annually, being in the proportion of four deaths being brought down to three deaths, or 25 per cent. less, and virtually declaring that where four people died previously, then only three shall die now.

The most reliable of all evidence has been obtained from soldiers, sailors, and the inmates of workhouses, who are all more or less under restraint and discipline. This is specially the case with soldiers, where the discipline is more strict and obedience to orders can be more rigidly carried out. Moreover, statistics derived from a body of soldiers are likely to be more accurate than from a body of civilians, for they are men at the most healthy period of life, and who are not influenced by diseases of the infantile period or by the ailments of advanced life, nor even by the uncertainties of trade. The mortality in our army at home was so large that a Royal Commission was appointed to enquire into the matter, and they found that the sleeping room accommodation was very unsatisfactory, there being only about 2 per cent. of our soldiers who had the proper quantity of air for a night's rest. The practical results of the enquiry by the Royal Commission led to larger air space or sleeping accommodation being provided, and associated therewith, better water and more of it, better drainage of barracks, and better food and clothing,

and very speedily the annual mortality in our Army at home came down from an average of 17½ in the 1000 to 8½ in the 1000, being about the half of the previous death rate when sanitary measures were not properly attended to. The various branches of the Service participated in this favourable result, as may be observed from the following table :—

DECREASE IN DEATH-RATE IN ARMY.

Infantry Regiments,	from	17·9 to 7·6	in 1000.
Foot Guards,	,,	20·4 to 9·1	,,
Royal Artillery,	,,	13·9 to 8·0	,,
Dragoon Regiments,	,,	13·6 to 8·0	,,

The subject of sanitary reform commends itself not only collectively to professional and municipal authorities, but individually to all of us, from the direct bearing it has on the strength and vigour, the health and life of ourselves and those dependent upon us. No doubt the physician and surgeon is now called upon to avert disease and ailment, as well as to cure it. The establishment of medical officers of health in our larger towns, and the diplomas in health granted by our Universities and Royal Colleges, sufficiently prove the importance attached by authorities to preventive medicine. Likewise our Municipal authorities are now called upon, and in some instances readily and cheerfully respond, to be the regulators of the air of towns, by the removal of all filth which can generate noxious gases to pollute the air, by more efficient water supply, by more thorough drainage and sewerage, and the ventilation of such, and by the stoppage of noxious trades, and otherwise.

We must not forget, however, and when we remember, we must not neglect to act upon the knowledge that in other aspects, sanitary reform is of a private or at most of a semi-public character, and must begin at home, in the ventilation of our rooms and houses, and the efficient cleansing of such ; in cleanliness of person and clothing ; in proper food, both solid and liquid, and in thoughtful interest and supervision of all home sanitary affairs, and such not only for ourselves, but also for those who are dependent upon us and who are to follow us.

In Health Statistics, I should almost say in Death Statistics,

young children have a sad tale to tell even in this the latter part of the nineteenth century. They are the most delicate Health and Death meters. Taking the most recent available and trustworthy statistics of the mortality in the eight principal towns in Scotland, we find the following results :—

IN 1881, DEATH-RATE OF THE EIGHT TOWNS IN SCOTLAND.
AVERAGE, 22·6 PER 1000.

Towns.	Population.	Deaths at all Ages.	Deaths of Children under 5 Years of Age.	Proportion of Deaths among Children to all Ages.
Glasgow, .	512,034	25·2	76·7	41·6 per cent.
Edinburgh,	229,030	20·1	59·9	36·8 „
Dundee, .	143,045	20·7	57·5	37·7 „
Aberdeen, .	105,515	19·4	48·6	34·5 „
Greenock, .	69,141	22·1	61·6	41·5 „
Paisley, . .	55,841	22·8	59·3	34·5 „
Leith, . .	61,607	20·8	56·4	40·2 „
Perth, . .	29,844	21·5	51·4	28·7 „

Taking, therefore, the average death-rate in the eight towns to be 22·6 in the thousand, or less than 1 in 40, we find the deaths among children under five years of age were per 1000—Aberdeen, 48·6; Perth, 51·4; Leith, 56·4; Dundee, 57·5; Paisley, 59·3; Edinburgh, 59·9; Greenock, 61·6; and Glasgow, 76·7; being in the proportion of 1 in 20 to 1 in 13, or from two to three times the death-rate of all ages including the children; whilst the proportions of deaths in the eight towns of children under five years of age to deaths at all ages were—Perth, 28·7 per cent.; Aberdeen and Paisley, 34·5 per cent.; Edinburgh, 36·8 per cent.; Dundee, 37·7 per cent.; Leith, 40·2 per cent.; Greenock, 41·5 per cent.; and Glasgow, 41·6 per cent. So that in Edinburgh for every 1000 children under five years of age, no less than 60 die every year, and out of the whole deaths occurring annually at all ages, we have more than 36 in every 100, or fully one-third taking place in those under five years of age, or those just starting in the race of life.

The Chemistry of Sanitation demands specially a knowledge of

air, water, and drainage, and every householder ought to possess a sufficient acquaintance with these three health agents, and which may be conveniently referred to as the air factor, the water factor, and the drainage factor. To some extent these health factors may be considered as separate agents at work in influencing the health of every home; but yet in various ways they are connected and react upon each other, for the air of a house may affect the quality of the water supply contained in cisterns or vessels, and the drainage of a house may influence both the air and the water, and indeed often does. But each agent may have a separate consideration to begin with, and the connecting links may be observed afterwards. Besides these factors there are questions relating to food supply and clothing, painting and papering of rooms, use and abuse of disinfectants, and other topics which more or less concern health.

In the Chemistry of a Healthy Home the air factor ranks first. It is probably the most important, and all the more so that it is the most insidious and least capable of being observed. Besides it is the largest quantity. In any house, large or small, the water supply occupies little space, and the food supply still less; but our rooms must be capacious, so as to afford a full and proper supply of air. Were it otherwise, and if a home were a mere protection from weather, even a box, such as a sentry-box, for shelter and for sleep might suffice. Then a tenement of a few square feet of floor surface would be all that would be necessary, where during the day we might have standing or sitting room, and at night lying down room, with little more relative space than herrings in a barrel, or packages of merchandise on the shelves of a store. Now such will not do. Mere elbow room is not all, nor even the principal requisite in a home, for our houses and our rooms must not only shelter us and provide us with sleeping accommodation, but they must also be our storehouses of air food, from which we must by day and night derive our rations of air food.

To some extent we are careful that our liquid food is partaken of from clean vessels, and a similar remark applies to our care of the solid food, so as to be sure that we receive

it in a pure and wholesome condition. The stated supply of solid and liquid food on two or more occasions during each day is not more important than the constant supply of air food which in many occasions during each minute is partaken of by each of us, and is breathed into our animal system. It is true that we pay for the solid food, and we see it on our platter, and can touch, handle, and taste it, and it is equally true that we pay nothing directly for the air food, and that we cannot see, touch, handle, or taste it. But as certainly as the man has his ration of solid food placed on the platter before him, so he has his allowance of air food measured out to him in the home he may choose to inhabit. Hence the necessity for cleanly homes to yield cleanly air for our momentary wants by day and night.

The amount of air required by man depends not only on size or bulk of each individual, but also to a great extent on age and exercise or work. The number of respirations at various ages may be thus tabulated :—

Infants,	44	respirations in each minute.	
5 years of age,	26	,,	,,
15 to 20 ,,	20	,,	,,
20 to 25 ,,	$18\frac{3}{4}$	,,	,,
25 to 30 ,,	16	,,	,,
30 to 50 ,,	18	,,	,,

The volume of the respirations is much influenced by exercise or work, as when the system is at rest the breathing is more quiet: when active walking or work is being gone through the breathing is not only more quick, but more earnest and deep. Thus the following results have been obtained for an adult :—

At rest,	33·6	cub. inches in each respiration.	
Walking 1 mile an hour,	52	,,	,,
,, 2 ,,	60	,,	,,
,, 3 ,,	75	,,	,,
,, 4 ,,	91	,,	,,

And when these results are considered along with the frequency of the respirations under different circumstances, the following table may be constructed :—

DAILY RESPIRED AIR.

Man at rest, - - - - - -	686,000 cubic inches.
Slight exercise, - - - - -	804,780 „
Tradesman at work, - - - - -	1,065,840 „
Labourers at work, - - - - -	1,568,390 „
12 hours' hill climbing on the Alps, -	1,764,000 „

It will, therefore, be found that an average sized man, engaged in very moderate work, breathes—that is, inspires and expires—about 1,000,000 cubic inches of air every 24 hours—every day. This amount is more than 500 cubic feet, and more than 3000 gallons of air. Were we required to purchase this quantity of air food, each of us would have to order a case or box full of air, 10 feet long, 10 feet broad, and 5 feet high, or if we choose to have it in quart bottles, we should have delivered to us more than 18,000 quart bottles per day. Indeed, for every hour we would require fully 20 cubic feet, being more than 120 gallons, and upwards of 700 quart bottles, and for every minute 2 gallons of air or 12 quart bottles. Just think of the alarm and dismay of every householder in the morning if the vendor of the day's air food was late in his call, and if the air boxes or bottles, like the rolls, were not delivered in lorries at the appointed time. Still more so if the manufacturer of the air, or his people, struck work for an advance of price; and worse still, if the air cleansing factory broke down or got burned up, and the material could not be supplied for love or money. We should then probably learn to hibernate for a time, like the Polar bear or the marmot, and go to sleep and hardly breathe at all.

We require not only quantity of air but quality of air to breathe. The atmosphere which surrounds us consists mainly of two gases, known to the chemists as oxygen and nitrogen. They are so largely present in the atmosphere that popularly we may say that the air is composed of one-fifth of the oxygen and four-fifths of the nitrogen.

Air Food.

Constituents of the Atmosphere.

Oxygen in 100 parts by volume,	- -	20·61
Nitrogen „	- -	77·95
Carbonic Acid „	- -	0·04
Water Vapour „	- -	1·40
		100·00

Ozone - - - - - }
Ammonia - - - - }
Nitric Acid - - - } traces
Carburetted Hydrogen }

Hydrosulphuric Acid }
Sulphurous Acid } traces in towns.

The oxygen is a most important gas for the life of all animals. When mixed with the nitrogen, we cannot see its properties so well as when we collect it in bottles by itself, and experiment with it in a pure and unmixed state. When obtained pure, it is a clear, transparent, colourless, tasteless, and odourless gas, which does not burn itself, but which enables a splinter of wood, a candle, a piece of charcoal, a bit of phosphorus, and even a coil of iron wire to burn brilliantly in it. Indeed, it is a great supporter of combustion, and burns everything more readily than air itself. The energy of its action in causing substances to burn so quickly in it, is due to its intense power to combine with, or enter into union with, the materials which are being burned, and when taken in its pure state, the oxygen is enabled to exert its power quickly and vividly, because it is not diluted or mixed with nitrogen, as it is in ordinary air. When we burn a candle, gas get, or coal in ordinary air, however, the combustion proceeds because of the oxygen of the air meeting with the combustible substances, and the rapidity of the process is kept down by the large amount of nitrogen which is mingled with the oxygen in the atmosphere.

The nitrogen of the air when taken separately is also a clear and transparent gas, colourless, odourless, and tasteless, and neither

burns itself nor allows anything else to burn in it. The main function it fulfils in the atmosphere is to dilute the oxygen and give bulk and weight to the air.

The breathing of man and other animals, otherwise known as respiration, is practically a process of combustion. The air which is inhaled enters the lungs and then passes through into the blood. The lungs contain from 5 to 6 millions of air cells, which though minute in size, yet from their numbers have a large surface of from 10 to 20 square feet, and such air cells inpinging upon the blood vessels enable the air which is breathed in by the lungs to enter the blood. The aerated blood is constantly circulating through the animal system, and the oxygen of the air in the blood burns up animal matters, so that when the blood returns to the lungs it has lost much of its oxygen, and contains instead of it a decided proportion of another gas formed of carbon and oxygen, and known as carbonic acid. This gas can be produced out of the animal system by burning a piece of carbon in a vessel containing air or oxygen, and may be proved to be carbonic acid by adding some clear lime water to the vessel and agitating, when a milky liquid will be obtained owing to the formation of carbonate of lime or chalk. In a similar way, if a man breathes into clear lime water, the carbonic acid which has been produced by the combustion in the animal system at once renders the lime water of a milky nature. The same result will be obtained by breathing into an empty jar, and thereafter adding the lime water and agitating. We can thus prove the identity of the combustion of carbon out of the body, with the respiratory processes proceeding within the animal system, and demonstrate that carbonic acid is the product of both processes.

The change which takes place in the air during the act of respiration is very decided. When taken in a dry state, the atmosphere in country places or rural districts contains from 20·96 to 20·98 per cent. of oxygen, and only 0·04 per cent. of carbonic acid, and in town districts from 20·87 to 20·90 per cent of oxygen, and 0·04 per cent. of carbonic acid. The proportion of the latter is therefore very small, and indeed is only 4 parts in 10,000, or 1 part in 2500 parts. But when the

air is breathed out again it contains only about 18·50 per cent. of oxygen, and 4·00 per cent of carbonic acid, so that whilst the oxygen has diminished by about 3 per cent., the carbonic acid has increased to 100 times the original quantity. Such air must be very different in quality from the ordinary atmosphere, and indeed when collected in a jar, and a lighted candle is introduced, the candle is extinguished, and when an animal is placed in it, the animal quickly dies. The air, therefore, which we breathe in is flame- and life- inspiriting air, but the air we breathe out is flame- and life- deadly air.

Not only is the expired air loaded with the noxious carbonic acid, but it also contains much water vapour and organic matters. The water vapour is not only given off from the lungs, but also from the skin during ordinary times by insensible perspiration, and when we are doing active work, by sensible perspiration, when we are said to perspire. Taking the more quiet periods, every man evolves water vapour by the lungs and skin to the extent of at least one ounce per hour, which comes to at least 24 ounces, or a quart bottle full, in the twenty-four hours. We can all observe this by breathing against a cold surface, such as a looking-glass, when the lung water vapour gets condensed on the cold surface; and we can also observe the skin water vapour by the damp condition of clothing and of stockings, when waterproof or rubber coats and shoes are worn. In rooms we can notice the water vapour, especially in a cold night, as it condenses on window panes and oil-painted walls. In halls and churches you can still further observe it, and if you wish to make an experiment on the subject you can take a fish globe or water caraffe, put some ice-cold water in it, and place it in a crowded room or hall. The animal water vapour condenses on the outside of the cold globe and ultimately drops from it. Taste that water, and it is mawkish from the presence of animal products which have been evolved with it; let this condensed water stand for a few days, and it will become somewhat fœtid, proving that it contains putrescent organic matters; and take a portion of it and examine it under the microscope, and you will find it the abode of myriads of minute living organisms, so numerous indeed that a single drop contains thousands, and so active that the busy life of a crowded

thoroughfare in our largest cities is not equal to the bustle of the denizens of our condensed animal vapour.

When the atmosphere is tainted by animal exhalations it is often an easy matter to recognise such when we enter from the open air into the crowded room or hall, and when, for a few minutes, the sense of stuffiness of the air, and even the odour of massed humanity is obvious. Of course, when in the crowd our sense of smell gets dulled, and requires a little sharpening by being again exposed to the outer air, before the nose recovers its proper functions. I know of no better place for demonstrating that human beings evolve by lungs and skin both water vapour and organic exhalations, than a well-filled railway carriage at a roadside station in a winter day, and where, when the train draws up, the window panes are found running with water, and as you enter you encounter a blast of fœtid vapour which almost overpowers you, and the stifling character of which is further evidenced by the sleepy, drowsy, and half-asphixiated state of the stupid occupants of the carriage.

Over and above the gases and vapours, the atmosphere of our rooms is liable to contain more or less dust diffused throughout the air. This dust may be partly visible at all times, and may be derived, to some extent, from the outside air during windy weather. The street dust of our large towns has been examined and analysed, and has been found to contain fragments of hay and straw, hairs and fibres, and pollen of plants, cotton and woollen filaments, wings and other fragments of insects, spores and germs of organisms, besides fine particles of lime, coal dust, sand, metal iron, &c. The dust taken from the roofs of houses, and even from the interior rafters, as well as that found on the tops of pillars, has been found to be similar in nature. The dust of our rooms, too, is of the same character, accompanied by minute fibres, hairs, and scales from skin. Even when the air of a room appears clear, as when daylight is streaming abundantly into it, the closing of the shutters, so as to leave only a slight chink for the sun to throw a beam of light across the room, reveals to the naked eye the numberless motes and particles which float about in the air.

The noxious effects of the gases and vapours we exhale have been at times mournfully illustrated. From our youngest days

we have all heard of the Black Hole of Calcutta, where 146 prisoners were confined with plenty of elbow room, but comparatively little air space, and practically no ventilation, and in a few hours 123 were dead, and only 23 survived, but with enfeebled frames which they never got the better of. Another catastrophe of the same kind occurred after the battle of Austerlitz, when 300 Austrian prisoners were confined in a small apartment with moving space, but not air space, and 260 died, leaving only 40 survivors with more or less wrecked constitutions. Again in a Londonderry and Clyde steamer some years ago, the steerage passengers were, during a storm, kept in the forecabin, and many died. But in most cases fatal results do not immediately follow, though the noxious effects are more or less apparent. The vitiated air in confined rooms, when breathed in part at least over and over again, soon throws the animal system out of tone, the general health becomes impaired, there is quickly a falling off in the muscular and nerve power, the man or woman becomes more or less unfit for work, the boy or girl more or less unprepared for school, and all become more predisposed to ailments, especially those of a pulmonary character.

The proportion of carbonic acid impurity in the atmosphere may be taken as the measure of the contamination, for though it does not include the water vapour and the organic exhalation, yet these have a certain relation in quantity to the amount of the carbonic acid. Every adult man evolves about 16 cubic feet of this noxious gas in the twenty-four hours, so that we may take half a cubic foot as a fair average amount yielded by every man, woman, and child during each hour. In our rooms, however, there are other sources of carbonic acid than the respiration of the occupants. Every gas jet yields it, and every candle and every oil lamp evolve it. Each small gas jet burning 1 cubic foot of gas per hour requires 10 cubic feet of air to burn it, and yields 2 cubic feet of carbonic acid, being as much as would be evolved by four of a family. An ordinary sized gas jet, say No. 2 burner, requires 25 cubic feet of air to burn it, and yields about 5 cubic feet of carbonic acid, being equal to ten of a family. A small paraffin lamp and an ordinary candle throw into the air as much carbonic acid as an adult. The combustion of these lights may not produce so much apparent

contamination as animal respiration, because the organic vapours are practically absent, but the quantity must be taken into consideration along with the respiratory products.

The necessity for the systematic removal of those aerial impurities from our rooms may be proved by their deadly character on flame and life. It is well known that where a candle or taper will not burn an animal will not live. It does not necessarily follow that where a candle will burn an animal will live, but where a candle is extinguished, you may depend upon it an animal will quickly die. Now take a jar of carbonic acid, and plunge a lighted candle into it, and the light instantly goes out. Indeed you can relight the candle, and place it in a second jar, and pour the carbonic acid from the first jar into the second, and again the candle goes out; and further, you can place the lighted candle in the open air, and pour the carbonic acid out of the jar and through the air over the candle, and though surrounded by the good air, yet our noxious gas extinguishes the flame or life of the candle. Even expired air blown from the lungs of man up into an inverted jar will extinguish a candle introduced therein, and demonstrates that the air we breathe out will not allow a candle to burn in it; and further, a candle or gas jet or paraffin lamp, when burning under a glass jar, pollute the air quickly, and speedily extinguish their own lights.

Now, how are we to guard our homes from the deadly influences we are daily engendering? First, we must have rooms airy, and not confined boxes; and second, we must see to the ventilation of our homes. The army regulations now demand that each man or soldier be provided with sleeping space in permanent barracks of 600 cubic feet, or in wooden huts of 400 cubic feet; when in hospitals at home, 1200 cubic feet, and at the tropics, 1500 cubic feet, or in wooden huts, 600 cubic feet. Take the soldier at home with the 600 cubic feet of air space. This requires a room 10 feet long, 6 feet broad, and 10 feet high. Of course an allowance must be made in a room for heavy articles of furniture, such as chests of drawers and our Scottish "kists," besides about 10 cubic feet for bed and bedding, and 3 cubic feet for an adult of 12 stone weight, as the rule is, that the space

occupied by a man may be reckoned by his weight divided by three. Even the 600 cubic feet for an adult is too small for sleeping accommodation, were it contained in a glass case, or the doors and walls hermetically closed to renewal of air, for a man will actually breathe nearly 200 cubic feet of air during an evening's rest of eight hours, and the mixture of this quantity of air which has actually passed through the animal system with the remaining 400 cubic feet would render the whole 600 cubic feet very noxious.

All modern sanitary experiments show that when the atmospheric amount of carbonic acid in any room rises from 0·04 in 100·00 of air to 0·06, being from 1 part in 2500 to 1 part in 1600, then the air of a room cannot be challenged as impure, but when the proportion reaches 0·07 and still more 0·10 in 100·00 of air, then the atmosphere of the room becomes stuffy, and organic odours can be observed. The permissible amount of carbonic acid which ought not to be exceeded in a room is 0·06 per cent., or an addition of 0·02 to the 0·04 of carbonic acid already existing in pure or normal air. Now an adult person breathes out ½ or 0·5 cubit feet of carbonic acid every hour, and that will raise no less than 2500 cubic feet of air from 0·04 to 0·06 per cent. of carbonic acid. Such an amount of air for every hour of the evening it would be impossible to supply in any room of an ordinary house, provided the air did not become changed during the evening.

The renewal of the air in our homes must take place by ventilation, either insensibly and practically beyond our control, or sensibly and practically within our reach and guidance. The *insensible* ventilation occurs in every room, even when closed, by the wind causing the air to pass in and out through all crevices and spaces in doors, windows, and flooring, and even through the plaster walls, bricks, and stone, as well as by the vents or chimneys, when people are careful enough to leave them open. The *sensible* ventilation takes place by open doors and by open windows, either in the room or in passages or staircases. The principles of ventilation are very simple when you know what they are, and the practical application of those principles is very easy when you know how to carry them out.

The spent or noxious gases or vapours, including the carbonic

acid, become diffused throughout the room in course of time, though when evolved from the animal system, and from candles, lamps, or gas jets, they are heated and tend to rise in greater part to near the roof, and accumulate there. This is done in spite of the carbonic acid being a heavier gas than air when cold, being half again as heavy as air. The accumulation of the carbonic acid and other vapours in the upper part of the room may be demonstrated by placing two burning candles at different heights under a tall glass jar, when the products of combustion will extinguish the upper candle before affecting the lower candle. In many rooms the stifling effect of the air near the roof may be observed by mounting a table or a ladder; and further evidence of the deadly properties may be gained by the effect upon house caged birds, which are often found dead when the cages are hung near the roof.

In the ventilation of any room, means should be provided both for the ingress of pure air and the egress of the foul air. A single opening at the roof or the floor can at the least only provide very defective ventilation. A candle placed in a jar, open only at the bottom, will gradually poison the atmosphere sufficiently to extinguish itself, and a candle placed in a jar or bottle with the mouth upwards and open will also be extinguished; but place the same candle in even a smaller jar, with a comparatively small opening near the bottom for the admission of pure air, and a similar small opening near the top for the escape of the foul air, and the candle will continue to burn vigorously. In the proper ventilation of our rooms, we must provide equally for the entrance of the good air and the exit of the bad air. The vent or chimney must always be an important ventilator—very powerful when the fire is on and the long chimney heated, but also, though less powerful, when the fire is not used, provided the damper is kept open, and the vent is not choked with a bag of straw or other rubbish. Always keep the vent open. It is a good ventilator of any room. The amount of air drawn in by an ordinary room-fire during the hour, runs from 6000 to 20,000 cubic feet according to the heat of the fire. In any case, it must change several times an hour the whole air of an apartment.

The ventilation of a room may be assisted much during its occupancy by a reasonable amount of ventilation, which may be

carried out without draught. An ordinary wind blows at the rate of 6 to 12 miles an hour, and such would be unbearable in a room where people were sitting. A current of air going at the rate of a mile an hour is equal to $1\frac{1}{2}$ feet a second, and such a current is not perceptible to the senses. When the air is flowing at 2 miles an hour, or 3 feet per second, then the draught begins to be observed. Now take a room and place a ventilator on two sides of it. Let each ventilator be 12 inches by 12 inches, or a square foot in size, or what comes to the same thing let each be 24 inches by 6 inches, or 36 inches by 4 inches, or several smaller openings, making up, like these, 1 square foot of opening in all. Have the ventilators not exactly opposite to each other, so that the current may not pass straight across the room. It is wonderful what an amount of air can pass through such ventilators very hour. Take the current as 1 mile an hour, or $1\frac{1}{2}$ feet per-second, and these square foot ventilators will pass fresh air into the room, and remove the used or foulled air, to the extent of 90 cubic feet per minute, and 5400 cubic feet per hour. Reduce your ventilators by one half, and say that each is 12 inches by 6 inches, or 24 inches by 3 inches, or 36 inches by 2 inches, and let the current of air be 2 miles an hour or 3 feet in the second, and you have the same interchange of air, being 90 cubic feet per minute, and 5400 cubic feet per hour. Have your smaller ventilators, and the low rate of flow of air, viz., 1 mile an hour, or $1\frac{1}{2}$ feet per second, and you pass in and out 45 cubic feet per second, and 2700 cubic feet per hour.

Without any special ventilation at all, but leaving the room door ajar by a single inch, or at most by two inches, and having the chimney vent open, then the ventilation will proceed in a somewhat satisfactory manner, still more so if the window can be opened a little. If the lower sash be raised, and a slip of wood be inserted on which the window can be closed down, it will leave a ventilating space between the lower and upper sashes, which will be found most effective and beneficial as a ventilator without much down draught, as the entrance of the outside air will be directed upwards as it passes into the room. An ordinary window sash, 3 feet wide, if raised in this way by a single inch, will give 36 square inches of ventilating surface, and

if the air blowing at 2 miles an hour, it will pass 2700 cubic feet per hour. Now remember, I am not advocating the benefit of draughts of air, and am not recommending people to sit in draughty rooms, but I am indicating various modes in which the air of a room, when it is occupied, may be rendered less foul by animal gases and vapours, and may be kept more sweet and more healthy. The application of any one of those methods in each particular case must be left to the intelligent judgment of the occupants of the rooms; and it is sufficient for my purpose that I impress upon all the necessity for the recognition of ventilating principles, and to the benefits to be derived from the practical application of such. Where a room can have ready access to the outer air, then the insertion of Tobin's tubes, which communicate with the outer air near the floor of the apartment, and pass up the side of the room for about 6 feet, so that the entrance air may be thrown into the upper part of the room, will be found very beneficial. In large halls, such tubes or shafts for the entrance of pure and fresh air work exceedingly well, and lessen much the stifling atmosphere, without giving rise to draughts of air. Any system of ventilating an apartment is most materially aided by a fire in the room, and the great safety in the occupancy of many of our small houses lies in the fact that the living and sleeping rooms are one and the same, and that the fire required for daily wants does triple service in the cooking of food, the warming of the apartment, and the ventilation of the home.

Whatever difficulties there may be in the ventilation of our rooms when they are occupied by sitters and sleepers, there can be none when morning time comes, and the husband goes to his work and the children to school. Then the intelligent housewife should see that the windows are thrown open, and if convenient the doors too, and let the fresh air flow in abundantly, not only to chase out the foul air, but to dry up the animal moisture, and burn up and oxidise the animal organic matters which have condensed on walls and furniture during the evening. Beds should be well aired, the blankets and sheets being turned over. Inattention to such aeration of rooms and to the proper daily cleaning of apartments and furniture leads to the encrusting of the walls, doors, and furniture, as well as bedding and carpets or rugs,

with animal organic debris, which in time begins to decompose, and communicates to the house a fusty and fœtid smell or odour, most difficult to eradicate by even half-yearly cleanings. These remarks should apply with greater force to bed closets than even to rooms themselves. All doors of bed closets should be kept wide open at night, if, indeed, they be not removed altogether. I believe it would be better to unscrew the whole of them, and let the day light and the day air as well as the night air have full access to the closets. The introduction of a ventilator in the back wall of the bed closet near the ceiling would be of service, if we only knew that the opening did not pass into some region worse ventilated than the bed closet itself.

The difficulties of efficient ventilation in rooms or halls where large numbers of people are congregated are admittedly great. A crowd of people in a field or even on a hillside, with nothing but the heavens above, often gives rise to headache and a feeling of faintness on the part of numbers of the crowd, especially if the wind is somewhat light. Still more so, we find the same sensations in the midst of a crowd on the street, and again increased if the crowd is in an enclosed space—say, between high walls or high houses. If there is difficulty in ventilating a crowd in such a confined place, there must be corresponding difficulty in ventilating the houses which may line the four sides of the square, and which may form one of the ordinary blocks of houses run up in this and other cities. Such confined blocks, with numerous room windows imprisoned within the four built-up sides, are common in our modern feuing plans, and the ventilation of the houses there are impeded much by such arrangements, especially when the houses are small in size, and do not run front to back, so that there can be no through draught, but the back houses must all depend on the comparatively stagnant and imprisoned air within the block for the ventilation they stand in need of. The opening up of pens, closes, or passages without doors would somewhat improve the condition of matters by causing more or less current in the aerial prison, but the proper remedy would be to ensure that one or two clear spaces from earth to heaven were left in each block.

Remember that the gases and vapours exhaled from our animal

systems by day and night form the atmospheric sewage of humanity, and the quantity of such is large. During each day every man, woman, and child consumes, on the average, 8 oz. or ½ lb. of carbon within the animal frame, and such in the population of Edinburgh, viz., 250,000, gives 125,000 lbs. of carbon, or more than 55 tons, which calculated by the year yields 20,000 tons of carbon. As exhaled this carbon is evolved as carbonic acid to the amount of more than 60,000 tons annually from man alone. Other animals will yield as much, and coal-fires, gas-jets, candles, and lamps will bring the total carbonic acid up to at least 300,000 tons each year. When you add to that the water vapour from the lungs and skin, and which for each human being averages 24 oz. or 1½ lb. per day, and for the population of Edinburgh 167 tons per day, or 60,000 tons per year, as well as that from other animals, and coal and gas, we get at least 200,000 tons of impure water vapour, making with the 300,000 tons of carbonic acid no less than 500,000 tons of aerial impurities from ourselves and our houses, which pollute the atmosphere and constitute the aerial sewage of the city of Edinburgh.

Granting that we who are the polluters do our duty to ourselves and our homes, and by efficient ventilation and cleanliness allow these impurities to escape from our houses into the open air, then we may rest satisfied that natural forces and natural agencies will not fail to assist us in getting rid of the pollution.

By the law of diffusion of gases, at work by day and night, in sunlight and in dark, in summer and in winter, all noxious gases and vapours which are allowed to pass into the open air are quickly diffused throughout the atmosphere. Winds waft the air to and fro on the surface of the earth. Rain showers tend to purify the atmosphere by washing down the impurities to fertilize the soil. Electric storms assist in clearing the air of noxious principles, and plants are ready to absorb the deadly carbonic acid, and give us back pure life-inspiriting oxygen in its stead.

Our part of the purifying work is very simple. All we need do is to cease imprisoning the polluted air within our homes, and put forth our hand to liberate the deadly and poisoned air, and the God-ordained natural forces and agencies then complete the mighty task.

The practical application of this lecture may be summed up in the following lessons :—

1. Pure air is food to us.
2. Polluted and stagnant air is poison, slow but not less sure.
3. Never let air stagnate in rooms or houses.
4. Have reasonable ventilation of our rooms, by open doors, or slightly open windows, or other ventilators.
5. Never shut dampers in grates, but remove them and keep the vent open.
6. Thoroughly air all sleeping apartments during the day, and lastly,
7. Assist and do not impede nature in the restoration of pure and wholesome air for the impure atmospheric sewage of humanity.

Remember, too, as household words for ourselves and our little ones—

That a healthy man in an unhealthy home is surrounded by circumstances which are opposed to the continuance of the robustness of his constitution.

That a healthy man in a healthy home has much in his favour in his sojurn through life on this earth, and

That even an unhealthy man in a healthy home has the advantage of much which will palliate his ailments and will tend to lengthen his days.

THE CHEMISTRY OF HEALTHY HOMES.

By Dr STEVENSON MACADAM, F.R.S.E.,
Lecturer on Chemistry, Surgeons' Hall, Edinburgh.

PART II.

In my previous lecture I stated that in the Chemistry of Healthy Homes there were three important agents at work—the air, water, and drainage—and that these might be regarded as the principal factors in a home on which health and sickness much depended. These subjects were entitled to separate consideration, but thereafter they were interlaced or intermixed with each other, and became directly or indirectly connected in various ways. The air factor has now been discussed as far as time will admit for its separate consideration, though afterwards we will require to connect it with sewer gases and sewer air. So far as considered we have arrived at the conclusion that an abundant supply of pure air is required by all of us, and that such can be obtained, even in towns, by proper and reasonable attention to cleanliness and the ventilation of rooms. One other illustration of the benefits derived by animals from pure air and ventilation may, however, be cited. The mortality among the French cavalry horses was, some years before the Italian war, extremely heavy, being annually from 180 to 197 per 1000, and simply by providing better ventilation in the stables the mortality came down to 68 in 1000, or less than one half, whilst when in open barrack sheds it became much less, and during the Italian war the mortality was almost nothing from disease or ordinary ailments. A similar result has followed the better ventilation of the English cavalry barracks, and now the mortality among the horses is about 20 in

1000 annually, one half of which succumb from accidents and incurable diseases.

The water factor would fall now to be considered, but three years ago it formed the subject of my Health Lecture in this Hall, and the full particulars on this factor will be found in the lectures published in 1881. But a few important points must be alluded to to-night in order especially to connect water supply with air and drainage. Whilst the quantity of water we require daily is very limited as compared with air, yet the much less quantity does not necessitate nor even indicate that we should be less scrupulous as to quality, not only at the fountainhead, or well, or spring on the mountain side, but in the home cisterns we hold or store it in, and in the vessels we use it from. Remember we are all water animals more or less. Three-fourths of the weight of our bodily frame consists of water, which is coming and going, and the waste must be replenished by pure water.

In Edinburgh, however, the householder need not concern himself much with the source of the water. We know it is spring and mountain water, wholesome in quality, and enlivened and rendered palatable with pure country hill air. It is otherwise, however, with much of the water supplied to the smaller towns, villages, cottages, and even mansion-houses throughout Scotland, where the water from wells or so-called springs is more or less contaminated with noxious organic matters, including sewage products derived from drains and cesspools, and numerous instances occur every season where such polluted waters give rise to or aggravate many ailments leading to sickness and even death. Great care should therefore be exercised in using water for drinking and cooking purposes, the quality of which may not be known.

When we receive even pure water into our homes we often contaminate it, and render it more or less unwholesome. For instance in Edinburgh the water is liable to be influenced by storage in cisterns :—

1st. From deposits which form in the cisterns, and are not periodically cleaned out. Earth and clay brought in by the water, and separating as a deposit when the water comes to rest, and to which is added the dust of rooms where the cisterns are

in living rooms, or communicate with such, as well as the dust of streets where the cisterns are in garrets or above the garrets, and occasionally small animals which are drowned in the water.

2d. From gases and vapours evolved from the animal frame, including animal water vapour, with organic debris or perspiration, rising and condensing in the cold water of the cistern; also skin scales and fragments of hair detached from the surface of the body.

3d. From gases evolved from drains and sewers when the waste pipe, as it commonly is, has direct communication with the drains or sewers, or otherwise communicates with impure matters.

The deposits in the cisterns become specially noxious when putrefaction and decomposition set in, and the products derived therefrom contaminate the water. This is markedly the case when the house is shut up for some time, and particularly during the summer months, when the water remains stagnant in the cistern, and when drawn off at first is unwholesome and injurious, alike from containing lead and organic matters in solution and suspension. The remedy for such contamination is to clean out the cistern with a soft brush every month or so, and to exercise great care, when the house has been shut up, never to use water from the cistern either for drinking or cooking purposes until the cistern and pipes have been thoroughly flushed out.

The gases or vapours from the animal system also contaminate the water, especially in cisterns placed in living rooms. The complete remedy for such is to remove the cistern to some other place, but such is not always possible, and hence the partial remedy of the daily ventilation of our rooms, and the periodic cleansing of the cisterns must be depended upon.

The gases from drains or sewers contaminate the water in cisterns in very many cases. The position of the cisterns is often objectionable, being placed over the closets or sinks, and the exhalations rising and being absorbed by the water, which thus becomes tainted. But the great mischief arises from the carrying of the waste pipe directly or indirectly to the drains, and from the ventilation of the service box into the cistern. Thus the waste pipe is often led into the closet immediately beneath

the pan, though sometimes further down into the water. The result is that at all times, from the more or less foul water in the pan or bend of the closet, gases of a noxious character must ascend the waste pipe and hover over the water in the cistern. If there is a deficiency of water in the closet, and the end of the pipe be uncovered, the gases will more readily rise, and granting that the water luting of the closet bend be deficient, either by suction or otherwise, the drainage or sewage gases will rise from the main drain right up into the cistern. The same remark applies to the gases forced back from the main drains or sewers, and which will, in part at least, escape up the pipe to the cistern. Another source of the contamination of the water of cisterns is from the service box, with its connecting tube, passing up into the cistern. When the closet is not in use, the pipe is empty of water and so is the box. Whenever the wire is pulled, the water fills the box and drives the air contained therein—and generally a little of the water, by the tube—into the cistern. When not in use the tube or pipes and the box must be polluted with gases, and these necessarily contaminate the water of the cistern whenever the closet is put in use. Any cover put over the cistern will aggravate the evil, for the gases will then be confined and be more quickly absorbed. A remedy for the evils attendant on this form of closet, is to run the waste pipe right through the wall of the house, and to have the ventilating pipe for the service box taken to the roof of the house, or through the wall. The evils of the sewage contamination of the water in the cistern will thus be averted.

We must remember that water has an enormous power of absorbing gases and vapours and organic matters. Even pure natural water contains from 7 to 10 cubic inches of gases in the gallon, but these are pure and wholesome gases derived from wholesome air. When the water is exposed to noxious gases in cisterns, then the impure gases dissolve in the water and discharge the pure gases. When the water has become impregnated with organic debris, such impurity may at times be recognised by the addition of Condy's fluid, when the purple tint will be more or less quickly changed to a brown shade, but the water may be im-

pure though Condy's fluid does not act. Clearness and transparency of water are not absolute evidences of purity. The contaminating particles are extremely minute, and are invisible to the naked eye. The noxious germs and organisms are equally so. Sometimes they may be active and hurtful, at other times latent and comparatively innocuous. Such impure water employed in dairies even for washing the cans or vessels, and still more for diluting the milk, leads to the marvellously rapid development and propagation of the noxious organisms.

The drainage factor is now considered of the utmost importance by all sanitarians, and chemistry has much to say about it. Fresh sewage is comparatively sweet and harmless, and were it to have free passage onwards, it would keep fresh till it escaped from our towns, owing partly to putrefaction not having set in, and in other part to the aëration and oxidation due to the oxygen dissolved in the body of water accompanying the sewage, and which would at the moment of liberation tend to oxidise or consume the escaping gases, and thus render them innocuous.

Taking matters, therefore, as we find them in the water carriage system, we may consider the preventive measures which may be adopted to guard against the evils of this mode of the disposal of sewage. These evils are mainly due to the production of sewage gases in our drains and sewers, and to the passage or escape of these gases into our houses. The primary cause of all the mischief is the lodgment of sewage in the drains and sewers, especially at the bends and in the hollows and depressions formed by badly laid drains or badly founded drains and sewers, and where the levels are either originally not attended to, or the subjacent earth has sunk or yielded below. Another source of the mischief is where the drains are imperfectly jointed and luted, and sand and earth fall in, tending to choke up the drain more or less, and either forming an elongated cesspool, or even forcing the sewage out of the pipes altogether and saturating the neighbouring ground, which may be close to or underneath the dwelling-house.

The main preventive measure ought to be to look well to the levels and thorough and efficient jointing, which would ensure

the rapid and complete fall or run of the sewage from the house to the main drain, and thence to the point of disposal, either on land or in the sea. Part of this work would fall on the individual householders or house proprietors, so far as the private or service drains are concerned; and the other part on the municipal authorities, so far as the main sewers are concerned. There are many instances in which the private or service drain has been shown to be at fault, and there are no doubt many cases in which the evil may be traced to the putrefaction of foul deposits lying festering and decomposing in the main sewers.

The chemical nature of the sewage gases is generally misunderstood. It is commonly said that hydrosulphuric acid (sulphuretted hydrogen) and carbonic acid, which are readily recognisable in the emanations from decomposing organic matter, are the types of the noxious sewage gases. No doubt the gases named are destructive to life when in quantity, but I am inclined to the belief that the more noxious of the sewage gases are evolved at an earlier stage in the putrefaction of the organic matters, whilst the sulphuretted hydrogen and carbonic acid are produced at a later stage in the decomposition. In fact, I believe that the main danger lies in the earlier stages, when gases and vapours of a true organic and combustible nature are produced, accompanied by spores, germs, and organisms. In the investigations into the nature of the gases evolved from deposits in drains and sewers which I carried out at the time of the Water of Leith Drainage Scheme, and which were embodied in one of the Blue-books of the Sewage Commission, it was a rare thing to find sulphuretted hydrogen in the escaping gases; and the bulk of the sewage gases were found to burn readily, showing their carbo-hydrogen character. The latter are not so observable as the sulphur compounds, and therefore not so quickly guarded against. Moreover, any one who has inhaled sewage gas, either in our large sewers or when a drain is opened, knows that hydrosulphuric acid (sulphuretted hydrogen) is seldom present, but, nevertheless, the gases exert a most debilitating effect upon the general health and spirits, giving rise to prostration and heaviness, headache and nausea.

In the majority of cases, and in fact with few exceptions, it may be said that practically no precautions are taken in the construction of house drains and their attachment to the main drains to prevent sewage gas from passing back into our houses. The closets have generally a direct connection with the drains and sewers; and not only so, but the waste pipes from the cisterns have in most instances a passage to the sewers either indirectly through the pan or bend of the water-closet, or directly to the drains or sewers.

Take the case of ordinary house service and connection with drains, as commonly practised or carried out. The closet, sink, and washhand basin are directly connected with the service drain, and the latter with the main drain, and the only preventive as to the escape of sewage gas from the service or main drain into the house by either of the conveniences lies in the plumbers' bends, which ought to be kept full of water. The security in such an arrangement depends solely on the water luting in the bends remaining there in sufficient quantity, and not being forced by the pressure of the gases in the main drain. Now, many circumstances will tend to render this system of water luting defective. There is the difference in level of the water in the main drain from time to time during the day and night, and still more during much rain, when it may be running almost full. The large volume of air displaced by the water must find its way out of the drain by the weakest point, and if that be by the bends, then the sewage gases will be forced into the house. Again, without increasing the actual bulk of water in the main drain, a sudden passage down of hot water will raise the temperature, and expand the volume of air in the sewer, and thus force the bends. Moreover, the reversal of the temperature of the water in the sewer from hot to cold will cause a condensation of the volume of the gas or air, and the suction of air through the bends, with the consequent more or less emptying of the water out of the bends.

In the event of the sewer being directly connected with the sea, the rise and fall of the tide will bring about a difference of pressure in the sewers and drains, and also lead to the forcing

of the gases back into the houses. In short, the bend traps, taken by themselves, are not trustworthy. Two closets or sinks placed on different flats of a house will tend to react on each other, and empty the water out of the bends. Thus, a rush of water down one closet will cause a suction and empty the bend at the other closet, and similarly a rush of water at the second will empty the bend at the first. Indeed, a decided rush of water from either closet will tend to clear both bends of the water luting owing to the common pipe acting as a siphon.

To remedy this evil, it has been suggested, and is occasionally carried into practice, that a ventilating tube is inserted in the service drain between the main drain and the closet or sink drain. Thus the closet and the main drain or sewer are cut off from each other so far as pressure of air is concerned by the ventilating tube. Any extra pressure in the main drain or sewer escaping by the ventilating tube, and any pressure exerted by water flowing down the closet being also allowed to escape by the ventilating tube. Now, this simple ventilator is a decided improvement, but taken by itself is not sufficient. Safety still depends upon the bend trap in the closet remaining full of water, but a sudden rush of water down the closet will tend to empty the bend by the tube acting as a siphon, and still more readily will this happen if two or more closets or sinks are situated on different flats.

The remedy, so far as the service drains are concerned, must be rendered more complete. We must put a stop to the entrance of sewer air into the sanctity of our houses, where the noxious gases are not only driven in by pressure from the main sewer, but are sucked in by the draught of every fire in our rooms. And this stoppage of the entrance of the sewer air must be done by trapping, carried out in a thorough manner between the house connection and the main drain. And still further, we must ventilate the private or service drain by level ground ventilators where these can be put in, and by pipes where the situation will not admit of such. And, further, we must carry the separate closet pipes to the roof. The flooding of the service drains by the periodic, say weekly, discharge of a large body of water from

a bath, or otherwise down the service drains, will also tend to keep them free and clean.

Where the closets ventilate into common stairs, as in many parts of Edinburgh, special measures should be taken to minimise the evil of this system by having ornamental gates at the street entrance wherever wooden doors are now placed, in order that abundance of air may enter, and the cupola, where there is one, should have a ventilating space underneath, or an upper stair window should be left open. In this way the foul gases tending to pass from the closets would be diluted with fresh air, and would escape readily, instead of being confined in the stair as at present, or only escaping into the houses on the various flats. The stairs which have no doors are preferable to those with doors, and the partially open stairs and landings, as practised in several new blocks of buildings in Edinburgh are an important step in the right direction.

Whilst the householder has been looking to the trapping, ventilation, and cleansing of his service drains, he should also call upon the municipal authorities to place the public sewers in a thoroughly efficient state, alike as to construction and as to ventilation. Sewage gases are formed more or less in all sewers, even when the fall or rise is good, from the greater or less amount of sewage glut which adheres to the sides and bottom of the sewers; and, of course, still more are the gases evolved when the fall of the sewer is not good, and when deposits of foul matter take place, especially where junctions are made, or otherwise where obstructions take place.

The quantity of sewage gas passing or being driven from sewers fluctuates much. In the early morning, when little water is flowing in the sewers, there is necessarily a minimum amount of water, and the air space is large, but towards breakfast hours the flow of sewage is much increased—about one-half of the whole daily flow coming away during the six morning hours—and the increase in sewage must necessarily displace the air in the sewers. Moreover, during wet weather the surface water must raise the volume, and during a flood or storm of rain, the sewers become more or less filled up with water, and the whole

gas must be driven out. Of course even showers of rain will cause some displacement of air, more or less according to the rain-fall. The influx of hot water, as on washing days or from steam boilers, such as condensing water or the blow-off, will necessarily not only increase the volume of water in the sewer, but will also expand the sewage atmosphere by the heat alone, and cause much of the air to escape.

The proportion of sewer air thus displaced or driven out of sewers by the above means must be considerable. Take a medium sized ordinary street sewer of improved shape, say 2 feet 6 inches by 1 foot 6 inches, which would present fully 3 feet of superficial area. A mile in length of such a main sewer would have more than 15,000 cubic feet of capacity, and granting that the minimum flow of sewage in this sewer is one-fifth of the total capacity, or 3000 cubic feet, the sewer air capacity would be the remainder, or 12,000 cubic feet. I say *sewer air*, because the air or atmosphere contained in the sewer is more or less contaminated with sewage gas. Now this 12,000 cubic feet of sewer air is liable to fluctuation in quantity from hour to hour, from day to day, and during dry and wet weather. At breakfast hours there is one-fifth more sewage, which means one-fifth less air, or 3000 cubic feet of sewer air displaced by sewage water, and driven out of the sewer in every length of one mile. During washing days, probably another one-fifth of extra water, and necessarily one-fifth or 3000 cubic feet more sewer air is driven out. In rainy days still more sewer air will be displaced, and during floods of rain the whole sewer air, or 12,000 cubic feet in every mile, will be driven out of the sewer.

When the town is situated on the coast, and the sewage is carried below high-water-mark, the rise of the tide will displace all the air in the sewer, and drive it out of the sewer, as the tidal wave rises twice a day. In towns where flushing is resorted to, the rapid passage of a large body of water down the main sewers must also cause the displacement, by fits and starts, of large volumes of sewer air.

Another element in the escape of sewer air from sewers is the change of temperature of the air itself. Hot water cannot

enter the sewer without heating the air above the water line in the sewer. In doing so it expands the air, which necessarily becomes more bulky. There is a definite law as to the expansion of gases by heat, which states that, taking the range from 0°C. to 100°C., being from the freezing to the boiling points of water, 273 volumes of air become 373, or more than a third of increase, so that under these extremes of temperature the 12,000 cubic feet of sewer air in every mile of main sewer would tend to become more than 16,000 cubic feet, or 4000 cubic feet would be dislodged from the sewer. But say that the hot water was sufficient to raise the sewer air only one-tenth of this, then 400 cubic feet of sewer air would be driven out of the sewer for every mile in length.

Now, towns have many miles of sewers, and the proportion of gas or sewer air displaced in each mile would be practically the same; and if we take 50 or 100 miles of main sewers, the quantity of sewer air evolved would be enormous. The upper ends of all sewers and drains and branches terminate more or less in or near our houses, and if there is no other escape for the sewer air, then into our houses the gas must go. Public authorities, as a rule, provide for the thorough trapping or sealing of all the street gullies, and there is no escape in that direction. Then, where the house trapping of the drain is weaker than the street gulley, and generally it is so, the house trap must yield, and the gas be forced into the houses. Moreover, as a rule, house fittings connected with baths, closets, sinks, &c., are notoriously bad, and are frequently fitted up with imperfect and leaky joints, and often the connection between the house lead pipe and the drain pipe is made within the house with bad cement, or no cement at all. Hence the saying, that our main sewers are retorts generating sewer air, which is led into our houses by our branch pipes or drains, in a manner similar to the retorts in our gas works, producing lighting gas which is laid on to our houses by branch pipes or gas fittings.

Now, what is to be done? First, we must stop the entrance of sewer air into our houses by trapping; second, we

must ventilate the private or service drain; and third, we must carry the drainage pipes to the roof. But having done all this, we leave the main drains still as retorts and as the principal sources of mischief, but with an increased difficulty of forcing a passage into houses so protected, and should the passage be forced, with a lessened evil by ventilation, which means dilution of the sewer air and a great deal more as we shall presently see.

The main drains or public sewers ought to have the pressure taken off, and the gases liberated without bringing such near our houses, and without fouling our service drains. Such can be done by (1) unsealing the street gullies; (2) erection of shafts, and (3) open street gratings.

The unsealing of the street gullies is not desirable, for this would lessen the power of retention of road scrapings and earthy matters which are swept along the gutters. And such would tend to block up or choke the main sewers, or at least hinder the ready flow of the sewage, and materially assist in forming deposits of organic debris in the main sewers.

The erection of shafts of large size, if numerous enough, would relieve the pressure, and admit of that part of the evil being removed. These shafts cannot be properly placed at the sides of houses, because they can only pretend to be escape valves or pipes, and no public authority should charge householders with the risk to health involved in having the open ends of our sewage gas retorts run up the sides of their houses. Of course the shafts might be erected in open spaces, and where such can be obtained, the pressure may be let off but with the minimum amount of ventilation. No one, however, would seriously think of ventilating a long corridor, or even a room, by high shafts run up at each end, but would desire to have more direct means for ventilating the corridor or room. The same principle ought to be applied to main sewers which cannot be properly ventilated by any number of high shafts.

When the true principles of ventilation are applied to the main sewers, the conditions are best fulfilled by open street ventilators or gratings on the level of the street. These gratings serve not only as escape valves when the outflow or inflow of the gases

require such, but they do a vast deal more, and they truly ventilate the sewers.

Sewer ventilation, properly so called, ought to serve three conditions,—

1st. Admit of the ready escape of sewer gas.

2d. Admit of abundance of air to dilute the gas before escaping; and,

3d. Admit of so thorough an ăeration of the main sewer, that any foul matter present there will be oxidized or burned up rather than enter into putrefaction.

The chemical action involved in the latter condition has not received that attention which it undoubtedly merits. It is strictly a chemical question, whether it is spoken to by chemists, by medical men, or by engineers. If any nitrogenous organic matter be taken and confined without ready access of air, it will enter into true putrescence. Gases of a most noxious character are produced, and, doubtless, at the same time numerous noxious germs or organisms. If the same organic matter be freely exposed to air, the putrescence is not so well marked, and oxidation soon takes its place. The gases produced are not so foul, and the danger is not so great. The free admission of the oxygen of the air tends rather to burn up the organic matter into comparatively harmless, though to some extent odoriferous, gases.

The same principles must be applied to our sewers. If we confine the organic matters there, then putrefaction in its more virulent and noxious form must take place; but admit abundance of air, and the putrefaction decreases, and oxidation now comes into play—and the more air, the more of oxidation and the less of putrefaction—reducing in fact the volume of putrefying gases to a minimum, and even when such are still produced in small quantity, they tend, by dilution with the larger volume of purer air, to be oxidised or burned, and are thus rendered practically innocuous. All of these conditions are best brought about by open street gratings numerously inserted in our main sewers. Sewage-polluted streams have their characteristic flora and fauna —vegetable and animal growths; but when abundance of pure water is allowed to flow down the stream, the sewage growths

which thrive luxuriantly in polluted waters cannot survive in the pure water, and the sewage life disappears. Doubtless, also, sewage-polluted air in confined sewers has also its characteristic spores, germs, or organisms which propagate in such polluted air, but when plenty of pure air is passed through the sewer, the noxious spores, germs, or organisms must fail to be produced, and must cease to exist.

Any notion of partial failure of the open street grating ventilators to remove every particle of smell, should only lead to a thorough inspection of the sewer in the neighbourhood as to its condition, and as to any deposited matter lying therein, and probably another ventilator or two introduced into the immediate locality may remove the offensive smell altogether. At all times we must remember that it is infinitely better that sewage gas should escape openly into our streets than steal insidiously into our dwellings; and that at the worst, the open street ventilator can only evolve a very dilute and practically harmless air compared with the foul tainted gas, teeming with noxious spores, germs, or organisms, which the unventilated street sewers can discharge into our houses.

The practical application of the system to Edinburgh is obvious. At present there is really no ventilation of the main sewers, which are the principal sources of the noxious and dangerous sewage gases. Some private drains are ventilated, but as these should be trapped from the main drain or street sewer, they can be of no use in ventilating the main sewers. If not trapped, then the private drain ventilation is dangerous, for the element of true ventilation and æeration cannot go on, and the illustration of the main sewer being a retort, forcing sewage gases into our houses becomes a reality. The time is more than come when the thorough æeration of the Edinburgh sewers ought to be carried out, and it is improper to delay. Both theory and practice commend the system. It is possible that the condition of some of the Edinburgh sewers may necessitate rebuilding of such, but this is a lesser evil than to continue the use of an unventilated, bad sewer. The thorough ventilation of the main sewers of Edinburgh, combined with the periodic flushing out of such, to

remove sedimentary matter lodging there, would undoubtedly be a great boon to the city, and its execution should not be delayed.

The amount of air which can be passed through a main sewer is very large. Thus if there be a length of main sewer having two street ventilating gratings placed 100 yards apart, such gratings have each a square foot of open or ventilating surface, and if the wind be blowing at the rate of 6 miles an hour, which is equal to 9 feet in the second, the air will pass through the sewer at the rate of 540 feet in the minute, or 32,400 feet in the hour, and the whole bulk of air in the sewer will be renewed 100 times during the hour. This dilution and aëration renders it impossible that any injury can be sustained from the escaping gases. The air, however, often travels at a much higher speed than 6 miles an hour, but taking friction into consideration, and even reckoning that the renewals of air were only 50 times or even 25 times during the hour, we may regard the system as not only efficient but safe.

Moreover, the foremost sanitary engineers and health authorities are unanimous in sanctioning and recommending the system, and many towns in England and Scotland have demonstrated the benefits to be derived therefrom. To come near home, Glasgow has between 2000 and 3000 of these open street ventilating gratings connected with the main sewers at about 70 yards apart, and Leith and Portobello are provided with them. Why should Edinburgh stand still? These ventilators are all the more needed, now when our streets are being so thoroughly asphalted and cemented on the causeway that the carriage path is practically impervious to water and air, and any gases evolved from our sewer pipes and gas pipes cannot escape through the causeway, but must be driven out below the pavements and into our areas and sunk flats. The open street ventilating gratings would relieve the pressure of these gases, and allow them to escape in the centre of our streets.

Besides the ventilation proper, there should be periodic flushing of all our main drains and sewers, by the opening of sluices connected with large cisterns placed at proper distances

apart. A sudden escape of a large volume of water down a sewer at a given time would tend to float on all the solid debris lying in the bed of the sewer, and thus remove the cause of the production of the sewage gases.

The sewage gases, when taken at their smelling stage and when sulphuretted hydrogen is being evolved, are not necessarily at the most dangerous stage. The sulphuretted hydrogen is well known in rotten eggs, and no doubt when inhaled the gas by itself is more or less noxious and deadly, giving rise to drowsiness, heaviness, and headache; and when in quantity has proved poisonous to birds and other animals, including man. But the proportion evolved from sewers or other sanitary arrangements is comparatively small, and should rather be regarded as an index of other changes and conditions leading to the disengagement of more noxious and hurtful vapours, including germs and organisms which form the greatest danger. No doubt, all the stages may be regarded as going on at once in portions of the same organic matter, and sulphuretted hydrogen is the best tell-tale of the putrescence of the whole. Indeed the sulphur gas may be reckoned as the tail of a lion, of which none of us would be very much afraid if it were by itself; but where the tail is, depend upon it the mouth and claws are not far off. The two latter are the most deadly, and the former may be played with, but taken all together, they are to be avoided.

Chemical agents are useful in emergencies to aid us in combating with sewage gases and polluted air. There are different classes of such, such as deodorisers which remove odours; antiseptics, which stop or arrest putrefaction; and disinfectants, which stop putrefaction and destroy odours, even rising into the air to do so. The properties of the deodorisers, antiseptics, and disinfectants may all be found in one chemical compound, and the agent is the better and more powerful when such is the case.

For the development of putrefaction in organic matter three conditions are required: (1) dampness or water; (2) moderate heat; and (3) air for germs, spores, or organisms. When meat or organic matter otherwise liable to putrify is dried up, it retains its freshness. Egg powder, which is prepared

by drying up eggs, is a good illustration, as the powder so obtained keeps all right. In various tropical districts, meat is cut into strips and dried in the sun, when it retains its good quality; and ordinary glue or gelatine being dry does not putrefy, though when made up with water and kept it rapidly gets mouldy. The absence of heat also preserves organic matter, as proved by cold or ice keeping meat fresh. The large importations of American beef into this country demonstrates this; and even from geologic times the mammoth elephant is found embedded in snow and ice in a preserved state. The absence of air with its spores, germs, and organisms, stops the putridity of meat and other organic matters, as observed in the large quantities of tinned meats, fish, &c.

As antiseptics proper, we can instance common salt, as in salted herrings and corned beef; chloralum; vinegar, as in pickles; and sulphites, such as bisulphite of lime employed for stopping the putrefaction of glue for paper size, and of meat by butchers, as well as hindering the turning of beer and lime juice. As useful oxidizers or aids in such, we have charcoal, which has been found of service in absorbing the noxious gases evolved from masses of putrescent matter when covering such, and in respirators to be worn by those who enter noxious localities, such as sewers; and caustic lime (lime shell in water), which is one of the best agents for sweetening the atmosphere of confined closes, areas, and stairs.

As powerful disinfectants we have chlorine in various forms, as well as burning sulphur or sulphurous acid, and carbolic acid. The chlorine by itself is a greenish yellow gas, possessing a suffocating odour, and rather strong for general use. In the form of bleaching powder it can, however, be obtained in a ready and available condition. A little powder placed on a plate and exposed to the air, evolves the chlorine slowly, and if desired that the evolution of the chlorine be greater, then some vinegar may be added to the powder. The chlorine has the power of causing the oxidation of the organic matter which it is brought in contact with, and can rise into the air and destroy gases and germs floating there.

The burning of sulphur or brimstone, which yields the gas

ordinarily known as sulphurous acid, affords also a powerful agent. 1 lb. of sulphur will yield 12 cubic feet of sulphurous acid, so that an ounce of sulphur will evolve three-quarters of a cubic foot of the gas. Before burning the sulphur in an apartment all metal articles should be removed, as corrosion of such will occur, and the windows and vent being tightly closed, the sulphur may be fired in a small iron pot, or on an iron shovel supported on a brick. The door being closed, the room is kept closed for at least two to three hours, after which the doors, vent, and windows may be opened for ventilation, and the room be thoroughly cleaned out. The fumes of the burning sulphur or sulphurous acid is a most powerful destroyer of living organisms. As little as one volume of the gas in 1000 of air will destroy ants and other animals, so that a couple of ounces of the sulphur burned in any ordinary apartment would be amply sufficient for its disinfection.

Carbolic acid is also an excellent disinfectant, and was known even in the days of Pliny, who states that it was prepared by the destructive distillation of wood, and that the liquor thus obtained was reboiled, and the heavy pitch oil collected on fleeces of wool. He talks of it as a "reddish pitch, very clammy, and much fatter than other pitch." We now obtain the carbolic acid from the coal tar of gasworks. It may be employed by itself as a useful disinfectant in many ways. Thus a little of the liquid when put in a plate, and some blotting-paper crumpled up and placed therein, readily communicates the vapour of carbolic acid to an apartment. The same thing will occur if a cloth be dipped in the liquid and suspended in the air. A wine-glassful added to a pail of water is useful for disinfecting clothes taken from a sick person, and which may be immersed therein; and a similar dose of carbolic acid in water may be successfully employed for washing the floors, walls, and furniture of rooms which have been occupied by infected persons. The liquid may also be beneficially employed in disinfecting closets, sinks, and drains, and in treating putrefying organic matters before removal. A handy form of the carbolic acid is given in the various powders sold in tins, and known as M'Dougall's and Calvert's disinfecting powders, and the daily use of such in closets and sinks will be found to sweeten the air. Car-

bolic soaps are now also used for the cleansing of clothes, the washing of hands of attendants on the sick, and for the treatment of certain skin diseases.

Condy's fluid requires a special place and special reference. It is an excellent oxidiser when placed on articles, or when such are put into it, but it does not rise as vapour into the air, and destroy gases or germs there. It is not a gaseous aid. It is, however, a very safe material to work with, and performs great service in the sick room, where it should be added to all utensils used by the sick.

The medical attendant on the sick will be the best judge of the special disinfectants which should be used in each case, and his advice should be rigidly and implicitly carried out in practice.

Remember, I am not recommending disinfectants as a general set off to uncleanliness in houses and their surroundings. I am merely speaking about exceptional remedies for exceptional cases. The proper remedy or cure is the natural one to remove filth or noxious material, and keep our homes and persons cleanly, and nature will do the rest. The daily removal of town garbage and fulzie by municipal authorities, as in Edinburgh, is the proper way. The accumulation of ashes and other house rubbish in middens and ash-bins, where putrefaction sets in, leads often during removal of the debris to sickness and worse, especially among children. Every householder should assist our municipal authorities in the rapid removal of the house debris, not only by himself, but by informing upon his neighbours who neglect to do so. It is often said that "one man's meat is another man's poison," and such is true, because one man will withstand influences which another man will succumb to. It is equally right to say that one man's neglect of sanitary measures or cleanliness may lead to disease and death in his neighbour's house. The natural outlet for putrescent solids—ordinary town or police manure—is the soil, which is nature's solid disinfectant, and the sooner the stuff is there the better, where it will fertilise the earth, and be not poison but food to plants, and through them in wheat, oats, or potatoes may become food even to man.

The natural outlet for the aerial sewage is the atmosphere,

where nature's air-disinfectant ozone is ever ready and able to help as the aerial scavenger to burn up our noxious gases. But do not throw too much on the air. There is a limit to its power of purification in towns and populous neighbourhoods. The soil is ever ready and is even greedy for manure food, and its capacity for absorption is practically unlimited, and all liquids and solids should be quickly incorporated therewith and be rendered harmless. Do not therefore hoard filthy matters in your homes, but send them at once to the fields to enrich the soil. Spare the atmosphere as much as you can. We require much of it, and should not needlessly pollute it by allowing putrescent matters to lie in our homes or around our homes which will evolve unnecessary noxious gases into the air. There is a limit to air purification, and even to the air itself. The height of the atmosphere is only forty-five to fifty miles—the distance from Edinburgh to Glasgow: an express train would run to the confines of our atmosphere in an hour—the time we have been in this hall. If the train halted a little less than $3\frac{1}{2}$ miles from the surface, the distance from Edinburgh to Portobello or Joppa, it would have left half of the air behind or below it, and would have only the other half in a more and more attenuated state to pass through in the remaining miles. The relative height of the atmosphere to the bulk of the earth is only 50 miles to 8000 miles, which is the diameter of our globe, or 1 to 160, being about the same as the thickness of a penny piece on a two foot globe.

A lecture on the Chemistry of Healthy Homes would hardly be complete without a reference to the cleaning of walls and ceilings, and painting and paper hanging. Before renewal of either paint or paper, the walls and ceilings should be thoroughly washed down, and the old paper hangings should be stripped off. It is absurd to think you get quit of a filthy ceiling by whitewashing over the dirt, and it is as fully absurd to suppose that the walls can be healthy if paper after paper is plastered over each other with flour paste. Such walls must always evolve gases owing to the more or less putrefaction of the coats of paste and paper. Never repaper over the old paper. Remove the old fusty papers and their coating of paste and dried up animal

exhalations, and repaper on clean walls. A little oil paint on the woodwork, some whitewash on the ceiling, and either ochre or a neat paper on the bare clean walls, will sweeten any apartment, but beware of using arsenical papers, especially the greens.

The injurious effects of poisonous colours may be inferred from the fact that when such colours are used, either in distemper work or in paper hangings, the dust of the room taken from the floor or cornices, and from the ledges of doors and windows, the tops of wardrobes, &c., is impregnated therewith, and is always more or less poisonous, and the more the walls are dusted and the floors switched, the more fine and diffused will the poisonous dust become, till it settles down as an impalpable powder on the bed clothes and bed hangings, ready to be wafted again into the atmosphere by the motion of the bed clothes and hangings, and to be inhaled by the occupier of the room. And further, there is the probability of the volatilisation of some of the poisonous compounds as gas, either from the dry state, or still more so from the moistened surface, as where the walls are more or less wetted by respiration and perspiration during the occupancy of the room in the evenings.

The poisonous results have been markedly observed in the case of the arsenical colours where ailments have been directly traced to the poisonous colours; and, time after time, the story runs that whilst the room coloured with the arsenical material leads to sickness and all the symptoms of arsenical poisoning, yet all such symptoms have disappeared when the patient has either been removed to another room devoid of poisonous colour, or the room walls have been stripped and cleaned, and fresh paper or colour devoid of arsenic has been supplied; whilst a return to the room in the old state has led to a relapse and a reappearance of the poisonous symptoms. In my own professional experience I have never known of a fatal case of such poisoning, though I am conversant with many instances of illness, but deaths have been reported in various journals to be traceable to the use of such colours. Of course, some people are more predisposed to the influence of poisonous substances than others, and to one particular poison more than

to other poisons, and hence one may be affected whilst nine, or even ninety-nine, may escape without apparently being affected deleteriously. The same picking out of individual cases is observed with water containing lead impregnation, where one or two parties in a community may be influenced thereby, whilst the others are not sensibly injured.

The main evil is undoubtedly due to the use of arsenic in the colours, and the greens are more decidedly arsenical than the other colours, though colours and paper hangings of all shades and tints may be found containing more or less arsenic. The principal poisonous colour is the arsenical green, which is not arsenic alone, but a compound of arsenic and copper, known to the chemists as arsenite of copper, and which is often associated with acetate of copper. The various mixtures and shades go under the names of Scheeles green, Vienna green, Emerald green, and Sweinfürth green, and contain as much as 50 per cent. of arsenic, besides the copper and other substances. Arsenical yellow is a compound of arsenic and sulphur, or the sulphide of arsenic, and is known as Orpiment or King's yellow. Chrome yellow is a chromate of lead, and is not only used as a yellow, but is also employed largely in mixture with Prussian blue in the compounding of many shades of green. In oil painting, the various compounds of lead, such as white lead, which is a carbonate and hydrate of lead, red oxide of lead, &c., are largely employed.

Now there is no necessity for using these poisonous compounds either in distemper or oil painting, or in paper staining, and the best evidence of this is in the large assortment of colours which have been manufactured by Messrs Manders Brothers of Wolverhampton, specially for distemper work, and not one of which consists of or contains poisonous materials. The colours include lime yellow, Dutch pink, finest French ochre, golden ochre, terra cotta red, Turkey red, pale Indian red, Antwerp crimson, lime red, lime violet, lime purple, lime brown, Turkey umber, Bath stone colour, Pompeian green, sepiacine, pearl gray, blue black, deep Victoria green, pale Victoria green, pale lime green, willow green, pale sylvan green, middle sylvan green, pale sage green,

deep sage green, deep sylvan green, neutral green, torquoise blue (blue shade), torquoise blue (green shade), ultramarine blue F.A., ultramarine blue D, lime blue, indigocine, and permanent white.

I have tested every one of these colours, and find them to be entirely free from arsenic, lead, copper, or other poisonous compounds, and consequently they are entirely harmless, whilst the various tints and shades are everything which can be desired. Indeed, no better colours need be used on our walls, and I am confident that the employment of such non-poisonous colours, in distemper work especially, would materially add to the healthiness of the community.

The instructions for the use of these non-poisonous colours are very simple. All papers should be stripped off the walls, and any old colour carefully washed off. Where walls or ceilings are stained, they should have a coat of quick colour made of zinc white, good size, and turpentine. Good size for distempering is best made by dissolving in water over the fire 1 lb. of first class glue, and adding more water, so as to make a bucketful of size of about $2\frac{1}{4}$ gallons. The colour for the preparation coat should be made by slaking the whiting in cold water, and adding the proper proportion of the colour, then reduce four ounces of soft soap in warm water, and add it to each bucketful of stuff, and thin down the whole with jelly size until it is fit for use. Lay on easily with a flat brush, and allow to dry. The colour for the finishing coat should be made with more colour and less size than that for the preparation coat, and the soft soap should be left out.

When properly put on the walls, these distemper colours are quite firm, and do not rub off. The colours are not liable to fade and do not tarnish by gases. They are very cheap as compared with wall papers, are very suitable especially for bedrooms, and nothing can be more cleanly or pleasing to the eye.

In regard to paper hangings, I exhibit on the screens a large number of patterns, including all the principal colours, and ranging in price from a few pence per piece to the high class qualities. Some of the papers are arsenical and others are not. The arsenical papers include greens, reds, drabs, blues, &c. Looking

at the various tints and shades which are arsenical, and contrasting those with similar tints and shades which are non-arsenical, there is absolutely no reason why our paper stainers should continue to use arsenic in the colours they place on the wall papers. No doubt it may be urged that arsenical green especially is a cheap and pleasing colour, but the non-arsenical papers exhibited on the screens, and which have been manufactured and supplied by Messrs Wm. Woollams & Co., of London, prove that the best of colours and patterns and the most pleasing effects are obtained without arsenic, and can be guaranteed to be pure from that poison. I have tested all these paper hangings, and can certify that they are entirely devoid of arsenic or arsenical compounds, and yet the samples contain greens, blues, reds, drabs, &c., fully equal in all respects to those present in the poisonous papers.

The proportion of arsenic in arsenical paper hangings is often very large, and may range as high as 40 to 50 grains in the square foot of the paper. Taking 40 grains in every square foot, a large-sized room, which has about 1000 square feet of wall surface (making allowance for doors, windows, fireplace, &c.), will have 40,000 grains of arsenic on the wall paper, and a small-sized bedroom with about 500 square feet of wall surface, will have 20,000 grains of arsenic on the walls. The dusting of such a room must detach some of the arsenic and diffuse such into the atmosphere, supplying abundant means for doing harm. Taking the amount of arsenic as even 10 grains to the square foot, we have respectively 10,000 grains and 5000 grains surrounding the walls, a quantity still alarmingly large, and yet much below what many wall papers possess.

Many other articles than wall papers are highly arsenical. Thin gauze cloth may be purchased containing 10 to 30 grains o arsenic in the square foot. Green coloured paper, glazed and unglazed, used for covering pasteboard boxes and labels, &c., I have found to contain from 16 to 45 grains in every square foot. In fact, a bandbox having 3 feet of surface will have 100 grains of arsenic, a cracker box from 30 to 40 grains, the crackers themselves 2 to 3 grains, labels on tinned meat cans and bottles from 6 to 20 grains, envelope bands 2 grains, children's picture books

sometimes 50 grains; besides artificial flowers, children's toys, water-colour paints, and ball-room cards and tickets, &c.

I have made no reference to the ailments of the workmen employed in mixing and using such poisonous colours and in the cutting and hanging of arsenical papers, but I have evidence, and in the south very conclusive evidence has been obtained, as to the deleterious and poisonous influence of arsenic upon the work people engaged in the trade.

I would therefore urge strongly the discontinuance of all poisonous substances in the compounding of house paints and the staining of wall papers, and would recommend our colour makers and paper stainers generally to follow the example of those firms who have already led the way to this reform. Other countries, and especially France and Germany, have shown us a good way of getting rid of the mischief by passing very stringent laws regarding the use of poisonous substances in articles of common use, and recently the Prefect of Police in Paris has notified a most stringent prohibition regarding the use of poisonous substances in the colouring of even wrapping papers, and has intimated that manufacturers and dealers will be held responsible for accidents which may occur from the employment of such. We cannot do better than follow the lead taken by France and Germany in this matter, but until the legislature adopts the necessary stringent measures for the general safety of the public, the individuals of the community must protect themselves by insisting upon the manufacturers and purveyors of all colours and coloured papers guaranteeing that they are free from poisonous compounds.

A new and wholesome way of decorating rooms has lately been introduced into this country by the employment of very thin shavings of wood pasted on paper, and then employed as paper hangings or for covering woodwork. The Spurr's combined wood and paper veneers are cut from the natural wood by taking the logs, which are first halved or quartered, and bolting them in a revolving section of a ponderous machine, weighing about 30 tons. The cutting blade is 12 feet long, and the log is cut across the thickness, and not down the length. At every revolution of the machine a veneer 12 feet long, and from $\frac{1}{90}$th to

$\frac{1}{178}$th of an inch in thickness, is thrown off, but such must be done without vibration, as the machine must work true and almost noiseless, in order to yield uniform and proper veneers. These veneers are then backed with paper to prevent waste, and enable an ordinary tradesman to apply them.

The directions for laying the combined wood and paper veneers are that the plastered walls must be rendered quite smooth, and any defects be filled in with plaster. The walls are then sized with hot glue, using about a pound of glue to the pail of water. The walls are then lined with thin muslin, in applying which the walls are pasted, and the cloth is put on dry and well rubbed down. The combined wood and paper hangings are then damped on both sides freely, when the whole swells evenly, and any uneven edges may be cut away with a shoe knife. In fixing to the wall, the best flour paste must be used, and the wood and paper hanging be well rubbed down on the wall. After drying, the surface should be smoothed with sand paper, and if there be any stains on the veneer, these can be removed by a very dilute solution of oxalic acid. The veneer should then be finished or filled in with wax dissolved in spirits of turpentine, and using white shellac for light woods, and orange shellac for dark woods.

In the application of the various wood veneers to rooms and articles of furniture, &c., it is recommended that red cedar be used for closets ; white wood, brown ash, or chestnut for pantries ; mahogany and black walnut for libraries ; black walnut for vestibules ; silver birch, curly, bird's eye, and silver maple, and satin wood for reception rooms and parlours, with blue and gold decorations ; and oak, ash or butternut for dining rooms. Ceilings may be made in every imaginable design, and wainscoting and wall dados in every device. Pianos, organs, tables, and other furniture may also be enriched in appearance in a similar way. The thinness of the veneers hinders contraction or shrinking by drying, or by alternate damp and dry weather. The lost sap is replaced by the wax, and all split panels or open joints are avoided by laying on the plastered walls at the extreme of the swell.

The advantages of the Spurr's combined wood and paper veneers may be summed up as follows :—

1st. The thorough natural character of the wood is obtained, and not mere imitation.

2nd. The beauty of the natural wood is brought out by the varnish.

3rd. The more perfect cleanliness, for the veneer hangings may undergo ready washing with soap and water.

4th. The non-liability to chip off, owing to the extreme thinness of the veneers.

5th. The improved appearance as age comes on, and which is well known in old wainscoting and panelling.

6th. The non-absorption of perspiration or animal exhalations, as in the case of ordinary wall papers.

The use of the combined paper and wood veneers has been going on now in the United States for fully twelve years, with increasing acceptance and extent every year. Latterly Messrs Elgin & Gilchrist of Glasgow have been supplying these veneers, and it only remains that the public in this country should be made acquainted with this new style of decorative art, to ensure its successful application to our homes and furniture.

Let me sum up.

On the important points of water and drainage brought forward in this lecture, I desire to note the following short lessons :—

1. Never use water for drinking and cooking purposes which has lain stagnant in cisterns or vessels.

2. See that the cistern is cleaned out every month or two, Probably this may be done by water inspectors in course of time, but householders should do it now.

3. See that all connection between the cistern and the drain is cut off, and that the waste goes to the outside of the house.

4. Attend to all closets and sinks, so that they shall be cleanly and sweet. If not there is something wrong.

5. Ventilate private drains by carrying the service pipe to the roof, and open the drain pipe at ground if space available.

6. Trap private drains from the public drains, in order that the gases from the main sewers may not invade the house, and

7. Call on the public authorities—our municipal guardians—to take example by the practice of other large towns and even

small towns, and ventilate the public main sewers by open street ventilating gratings, and thus aërate the main sewers, and consume the sewage gases at the moment of their birth, or even hinder their production and render it impossible for the deadly enemy to exist or be an enemy at all.

As for disinfectants, use but do not abuse them. Their use is for special, local, and temporary purposes,—where illness invades a home, or where sanitary measures cannot be carried out at once. Their abuse is when health measures are neglected, and noxious matters are cloaked over, and closets, sinks, and drains are not attended to, and people trust blindly to them. In such cases they are like the scents and perfumes of former ages, which were used to hide uncleanliness of person, and ill-washed domiciles. Remember that disinfectants do not cure the evil. They simply ward off the attack for the time, and the proper remedy is the removal of the nuisance.

In conclusion, let me state that if another sentence be required to enforce the benefits of health measures, it may be found in the following words, which ought to be household words:—

Pure air, wholesome water, and well ventilated drains reduce sickness and death-rate in any house and in any populous place.

One less death in 1000 of the population in Edinburgh means about 250 fewer deaths in the year, or five less in the week.

Let one of the five during the week be a bread winner for a home, with a probable wage or earnings of £1 per week—£50 per year.

Then remember that this sum derived from capital safely and properly invested would mean at least £1000.

So that the bread winner in his earnings for his home is worth £1000 in cash or invested capital.

During the year, 50 such bread winners saved by sanitary measures would mean £2500 of wages for support of homes, and an invested capital of £50,000.

Were a man a mere machine—a piece of clock-work—costing or worth £1000 and earning £50 a year, how carefully it would be tended and cared for. But man is more than a wage-earning machine. He is the Head of the Home, with all its duties and all its responsibilities.

THE HANDS AND THE FEET.

By Professor Wm. TURNER, M.B., F.R.S.

The subject of this lecture was chosen for me by an accomplished lady, an active member of the Committee of your Society; and as the Committee has approved of the subject, I may conclude that your Society is desirous occasionally to interrupt the ordinary course of lectures, such as you have from time to time had delivered to you—upon either personal health or public health—by lectures upon such branches of anatomical and physiological science as may be regarded of sufficient general interest.

In commencing to say something to you about the hands and the feet, it may be advisable that I should, in the first instance, make one or two prefatory observations on the structure of the body generally. If you look at the Human Body, or at that of any vertebrated animal, a glance will satisfy you that it consists of a trunk surmounted by a head, and of certain more or less elongated parts which are called limbs. Now the trunk and the head are infinitely more important in connection with the general structure of the body than are the limbs, because the trunk and the head contain those organs which are essential to the proper performance of all the functions of life. You cannot remove the head or cut the trunk into pieces without at once putting an end to life; but you may cut off a limb, or you may indeed cut off all the four limbs, without life being put an end to, so that in this way the limbs, you will observe, are quite secondary in their construction and function. They are, as it were, appendages added to the trunk for particular purposes, and as a general rule they are arranged in pairs, two, in man, in the upper part of the body, two in the lower. If you look at animals lower than man you find that the limbs are not situated one above the other, but one pair in front of the other.

Now if you proceed to examine a limb so as to see what it consists of, you will find that it may be divided into three fundamental parts—the girdle, the shaft, and the free terminal end. The girdle of the limb is that part of the organ by means of which it is attached to the trunk. The shaft of the limb is situated between the girdle and the terminal part, and gives length or reach to the limb. The shaft of the upper limb is jointed to the shoulder girdle at the shoulder joint; that of the lower limb to the hip girdle at the hip joint. The shaft itself is divided in the upper limb into an upper arm and a fore-arm, and the elbow is the joint of articulation between them; whilst the shaft of the lower limb consists of the thigh and the leg jointed together at the knee. The free terminal part of the limb is either the hand or the foot as the case may be. Now you may regard the girdle and the shaft of the limb as subsidiary in their function to the hand or the foot. It is the hand or the foot, as the case may be, which gives distinctiveness and specialization, if I may so say, to the limb, whilst the shaft and the girdle are arranged in such a way as to bring the hand or the foot into the best position for performing that use or function which the limb has to perform.

Let us now consider for one moment what are the primary uses of the limbs. And we shall look at them, to begin with, in the human body, in which they are called upper and lower. The primary use of the upper limb in man is to act as an organ for grasping and holding—it is what is technically called the organ of prehension, and it has this name from the power which resides in the hand. But the human upper limb may also have a secondary use, as an organ of progression, that is to say, as an organ by means of which the body can be moved about from place to place. It is only seldom that we use it for this purpose; but we do so when we are swimming, and when we are climbing a tree. The primary use of the fore limb, which is the corresponding limb in the quadruped, is not for prehension, *i.e.*, for grasping or holding, but for support and progression, and you find this limb variously modified in different animals, in order that it may be adapted for enabling them to move about from place to place. Secondarily, however, it can be employed by some animals for purposes of

prehension, thus apes can hold objects with the fore limb, and so also can a squirrel; whilst in such animals as the cat or the lion the fore limbs are used for striking its prey, and even for holding it between its fore paws.

Let us now look at the lower limbs in man, the primary use of which is entirely different from that of his upper limbs, for they are organs of support and progression, *i.e.*, the organs on which he stands, and which are put in action when he wishes to move about from place to place. Secondarily, undoubtedly the lower limbs can be used as organs of prehension, because we can grasp objects with the toes, but this again is an entirely exceptional occurrence. The same primary function of support or progression applies also to the hind limb of quadrupeds; but there are certain animals which can use their hind limbs as organs of prehension, and the most notable of these are the monkeys and those large apes like the gorilla, orang, and chimpanzee, which from a general resemblance in the form and structure of the body to man are called anthropoid or man-like.

Now I have told you that the hand or the foot is the free, distal, or terminal part of the limb, upper or lower, fore or hind, as the case may be, and we should in the next instance consider what is meant by the hand and by the foot. If this consideration were to be limited to what we see in our own bodies, there would be no difficulty in framing a simple definition of these terms. But it is impossible for us in the study of the structure of man to dissociate it from that of other vertebrates. Man in his structure is not to be regarded as a thing apart, but must be studied along with those animals which in their bodily organisation most closely resemble him, so that we cannot say that the hand is exclusively human any more than that the foot is exclusively human. Properly to realise what these terms signify, we should look at them from two points of view: either with reference to their construction, that is to say, what they consist of, and how their constituent parts are put together, and that is their anatomy; or with reference to the use or function to which they are put, and that is their physiology. Anatomically speaking, we may say that the hand is the free terminal part of the upper limb in man, or of the fore limb in a quadruped in which certain bones, joints,

muscles, and other soft parts, are arranged with reference to each other in a particular way, altogether irrespective of the function which they may have to perform. Also, we may say that the foot, anatomically speaking, is the free terminal part of the lower limb in man, or of the hind limb in a quadruped, in which certain bones, joints, and muscles, and other soft parts, are arranged in a particular way without any reference whatsoever to the use to which the limb may be put. But speaking as a physiologist, one would say that the hand is the free terminal part of a limb which is used for the purposes of prehension, and that the foot is the free terminal part of a limb which is used for purposes of support and progression, quite irrespective of the bones, joints, muscles, and other soft parts which enter respectively into their construction.

If I were to treat the subject anatomically, I should have to trace the various modifications which the bones, joints, and soft parts exhibit in man and different animals both in the hand and foot. I should have to point out to you how, starting with five digits as the maximum number in the hand and foot of man and various quadrupeds, one may, by the disappearance of one digit or another, at last reach that stage of structural simplicity where only a single digit exists, as in the horse and other solipeds. And further, one might indulge in speculations as to how a quadruped which at the present epoch has only a single digit, may have been derived by descent from one which at a former epoch had possessed two or even three toes.

But I think, perhaps, that addressing, as I am now doing, a general audience—one which, though not strictly scientific, is still desirous of knowing something about anatomical and physiological science—it may be better that I should look at this subject more from the physiological than from the anatomical point of view. And as the time at our disposal is limited, we will specially concentrate our attention on the human hand.

The human Hand is the highest type of hand. Now let us think for one moment of some of the things that have been done by the hand of man when inspired, and guided by an efficient brain and intelligent mind. It has built the Pyramids of Egypt in all their symmetry and massiveness; it has produced in metal

filagree work, and in thread lace work which rival in their delicacy and beauty the fineness of gossamer; it has modelled in the marble of the Venus of Milo a figure which in its form and proportion embodies the highest type of female grace and beauty; it has depicted on canvas in the great Sistine Madonna a countenance filled with the mystery of humanity. When we contemplate work so wide in its range and so varied in its character, we are naturally tempted to ask what is the construction and mechanism of the human hand which enables it to be applied so effectively for the discharge of work which in one direction requires the exercise of great strength and freedom of movement, and in the other delicacy and lightness of touch, combined with movements so fine as to be almost imperceptible.

The human hand consists primarily of three parts—one called the wrist, another the palm, and a third composed of the digits, which are five in number, so that the hand in man is pentadactylous. Five is the highest number of digits which you will find either in man or any existing mammal as the normal development, although rudimentary supplementary digits are occasionally produced.

To each of these digits in the human hand a special name is given. The first and most important is the thumb. It is the shortest of all the digits, but it is also the thickest, the strongest, and the most active. The Romans called it by the name of *pollex*, from the verb *polleo*, which signifies power. Another name which has also been given to it by Latin writers is that of *digitus doctus*, the instructed or skilful digit, expressing by this term how much the skill of the hand depends on the thumb. But the power of the thumb is also recognised in familiar speech. We say, for example, that one man has another man "under his thumb," that is, completely under his control. I need scarcely tell you of the well-known Scottish proverb, "Ye needna fash yer thoom;" it is not worth while troubling yourself to exercise the power of your thumb to do it. But perhaps the most exalted conception of the thumb is found in the idea of creation which prevails among the Esquimaux, who, it is said, believe that the woman arose out of the thumb of the man. But even the thumb, like all great things or persons in power, is at

times subject to the language of depreciation. Thus one may hear it said of a person who is clumsy in the use of his hands, and not dexterous in performing mechanical work, "Oh, his fingers are all thumbs."

Next to the thumb is the index finger, that is to say, the finger that we point with or beckon with, and this is the most moveable of all the fingers, which is the reason why it is used as the index or beckoner. I shall have to show you as we go on the anatomical reason why we use it as a pointer. Then the next is the middle finger, which is the longest of all the digits, and from its length it is a very important member of the hand. Next in order is the finger that we are all familiar with as the ring finger, around which custom prescribes that on the left hand of a married woman—though not of a man—the wedding ring should be worn. This custom is of great antiquity, and goes back to classical times. The Romans called this finger the *digitus annularis*, and it was selected for the ring, because it was believed that a nerve passed directly from this finger on the left hand to the heart. I need scarcely tell you that no such nerve has ever been seen, but the belief seems to have initiated the practice. Neither the ring nor the index finger is so long as the middle digit. In some persons the ring finger is longer than the index, in others the opposite prevails, and in others again they are of the same length. Even the two hands of the same person may differ in the relative length of the two digits. Last of all is the little finger, which is the shortest of the fingers, and the least important of all the digits.

Now let us look at some of the most striking properties of the hand. It possesses flexibility, elasticity, mobility, and sensitiveness of touch.

Its flexibility and elasticity are due to the number of bones and joints which it contains. The bones of the hand are twenty-seven in number, and are arranged in three groups—bones of the wrist, of the palm, and of the digits; eight small or short bones enter into the formation of the wrist, and are called carpal bones; five elongated bones lie in the palm, and are called metacarpal bones; whilst fourteen bones enter into the formation of the digits, viz., three in each finger and two only in the thumb. These bones are called phalanges, because they are arranged

in rows like the soldiers in a Greek phalanx. If we compare the skeleton of the hand with that of the shaft and girdle of the limb we shall see that the number of bones in the hand, limited though it is in size, far exceeds those which we have in the other divisions of the limb. Thus in the girdle there are only two bones, the shoulder blade (scapula), and the collar bone (clavicle), and in the shaft, notwithstanding its great length, there are only three bones, one in the upper arm (humerus), two in the fore-arm (radius and ulna). The great number of bones in the hand necessarily leads to the formation of numerous joints, of which there are between thirty and forty.

Next as to the elasticity. Wherever you have a moveable joint there you have material which serves elastic purposes, and so with the multiplication of joints you have necessarily a multiplication of elastic structures, because every one of the bones of the hand at the surface where it is jointed to another bone, is covered by a layer of elastic material which we call cartilage, and these elastic cartilages serve as buffers to break the violence of a shock; and we know perfectly well that the hand is a region of the body which in the various uses that it is put to is very liable indeed to receive shocks, and sometimes of a very severe character. You give a blow with some force, striking a hard body, and necessarily a certain shock is imparted to the limb, but that shock is broken from the number of joints and the plates of this elastic cartilaginous material.

Let us look in the next instance at the mobility of the hand, clearly a very important factor to be taken into consideration. The mobility of the hand is provided for in part by the number of bones entering into its formation, in part by the forms of the surfaces of the joints, and in part by the numerous muscles that are attached to its different bones. These muscles are in some instances of considerable length, and pass from the fore-arm to the hand. They possess long tendons or sinews, which as they pass either in front of or behind the wrist are retained in their place by strong ligaments. Those behind the wrist go to the back of the hand, and are called the extensor tendons; those in front of the wrist enter the palm, and are named the flexor tendons. Others of the muscles are short and confined to the hand itself; one

group forms the eminence known as the ball of the thumb, the other the eminence of the little finger.

In the study of the movements of the hand we have to direct our attention partly to those movements as a whole, and partly to the movements of the individual digits. The movements of the entire hand take place at the wrist, that is, at the place where the carpal bones are jointed to the lower end of the bones of the fore-arm. At this joint you can move the entire hand forward for a very considerable distance towards the front of the fore-arm; you can also straighten the hand out until it is in line with the fore-arm, and then you can bend it backwards, and the path of movement which the hand takes in these directions is in the antero-posterior plane. But you can also move the hand from side to side in the transverse plane, so as to bring either the thumb or the little finger into proximity with the corresponding side of the fore-arm. But further, these various movements may be combined or continued into each other, so as to make the path of movement a cone, the apex of which is at the wrist. Hence the range of movement at the wrist joint is very extensive, and you have but to consider the various things that you do with the hand in connection with its movements as a whole to realise how important this freedom of movement is.

But along with the movements at the wrist joint we should look at the mode in which the hand moves in conjunction with that bone which is called the radius, or outer bone of the fore-arm. The radius rolls about the ulna or inner bone of the fore-arm in the movements of what are technically called pronation and supination. When I present my hand to you so that the palm is directed upwards, both the hand and fore-arm are in the position of supination; and if I then move my hand so that the palm is directed downwards, both hand and fore-arm are thrown into the prone position. Now observe that these movements do not take place at the wrist joint, but between the two bones of the fore-arm itself. And as the radius is the bone which moves, and as the hand is jointed at the wrist principally to the radius, the movements of the radius also produce those of the hand. These movements are of the utmost importance in connection with much that the hand has to do. I

may instance, as examples, the acts of writing, painting, or drawing, in which there are not only slight movements of the thumb and fingers between which the pen or pencil is held, but gentle movements at the wrist, associated with a small extent of pronation and supination between the bones of the fore-arm. And observe what we always do with the fore-arm, when we are about to use it and the hand in performing these prone and supine movements. We semiflex the elbow, because then a hollow at the upper end of the radius is brought into more precise apposition with an eminence on the lower end of the bone of the upper arm, that is, the humerus, and in this way provision is made, by giving a definite surface to the radius on which it can move, for pronation and supination to take place with the utmost precision.

In the next place, we will look at the movements of the individual digits, which are also of very great importance. We must give the first place to the movements of the thumb, because this, as we have stated, is the most important digit. Let us consider for one moment what the thumb can do. Look at it in our own hands, and we shall see that we can bend the thumb, or straighten it, or draw it away from the index finger, or approximate it to the same finger; and further, we can throw the thumb across the front of the palm. This last movement is technically known as the movement of opposition, in which we oppose the thumb to the other digits, and can touch with the tip of the thumb the tip of each finger, or indeed any part of the palmar surface of any one of the fingers, or a considerable part of the palm itself. The movement of the thumb in opposition to the fingers is of the utmost importance, for it is that which more especially gives power to the human hand, and enables it to act so admirably as an organ for grasping or holding. If we want to take hold of any large object, we encircle it not only with our fingers, but with the thumb, whilst a smaller object is held between the thumb and one of the fingers, usually the index or middle. We have, therefore, a much firmer grasp than if we were to encircle it simply with our fingers, or hold it between any two of them.

The thumb, therefore, in addition to the muscles which can bend and straighten it, can draw it from or to the index

finger, has an additional muscle, the *opponens*, especially developed for performing the movement of opposition. It is attached to the longest of all the bones of the thumb, viz., the metacarpal bone, so that it exercises power over the whole digit, and throws it across the surface of the palm. But this extensive movement could not be carried out unless the joints of the thumb were so constructed as to admit of it. Accordingly we find that the joint between the metacarpal bone of the thumb and its corresponding carpal bone is so constructed as to allow of considerable movement. In this respect the thumb differs materially from the fingers, the metacarpal bones of which have scarcely any movement on their carpal bones. There is also another arrangement which restricts the movements of the fingers but not that of the thumb. For the four fingers are all tied together by a ligamentous band which is called the great transverse ligament of the hand, so that there is only a very limited power of separating them from each other; but this ligament does not pass to the thumb. If it had done so, then the thumb would have been tied to the index finger, and necessarily its freedom and range of movement would have been much more limited. But whilst we speak of the opposition of the thumb we must not limit our conception of the movement of opposition as a whole simply to the movement of the thumb. The other digits participate also to some extent. In this place I shall refer to the little finger, to the metacarpal bone of which an *opponens* muscle, corresponding to the *opponens* muscle of the thumb, is attached. This muscle possesses a certain power of throwing the little finger forward. Now when both the thumb and the little finger are thrown forward by the action of their respective *opponens* muscles, observe what you do with the hand. You hollow the palm into a cup, and this cup is named after the old Greek cynical philosopher, the cup of Diogenes. Many of you doubtless recollect the story how he used to employ a wooden cup as a drinking vessel; but one day he discovered that he could use the palm of his hand for this purpose, and so he threw the cup away as a superfluity.

In the next place, we will consider the movements of the fingers. We can bend or throw them forwards towards the palm.

Then we can straighten and throw them into a line with the palm, and even bend them slightly backwards. But, further, we can draw the fingers apart from each other; and when we combine this movement with the separation of the thumb from the index finger, we broaden the hand. Then we can approximate the fingers so that they come in contact with each other by their sides. For the purpose of performing these various movements there are appropriate muscles. Situated on the front of the fore arm are two muscles called the superficial and deep flexors or bending muscles. They give rise to eight tendons which pass in front of the wrist to the palm. To each finger two tendons proceed, one to be attached to the second, the other to the third phalangeal bone. In the palm itself are four small muscles, which from their worm-like form are called lumbricals, and these end on the back of the first phalanx of their respective fingers; so that each phalangeal bone has a flexor muscle connected with it. By the action of these muscles not only can each phalanx be bent on its neighbour, but the entire finger on the surface of the palm. This it is undoubtedly that gives such great power in seizing an object with the fingers, for we can make them assume the form of a series of hooks by means of one and all of which objects can be grasped.

When you bend the fingers and at the same time keep the last phalanx straightened on the second, you will see that the tips of all the fingers are directed to the ball of the thumb, so that the fingers cross obliquely in front of the palm and are in this way approximated to the thumb. Now this is a very interesting movement, as by it the entire series of fingers become opposed to the thumb, and as we have already seen that the thumb by muscular action can be opposed to the fingers, the thumb digit and finger digits meet each other. In this manner the hand becomes a much more thorough instrument for grasping and holding than would have been the case if the direction of the movement of the fingers had not been towards the thumb.

The conversion of the hand into a fist or instrument for striking a blow is produced by bending the fingers tightly on the palm, and by bending the thumb on the fingers.

Now let us look at that opposite action which is called exten-

sion or straightening of the fingers. The extensor muscles which are concerned in producing it are situated on the back of the fore-arm, and form long tendons or sinews which go to the back of the fingers, and end in the back of the second and the third phalanges. If we examine these tendons as they lie on the back of the hand, we shall find an anatomical explanation of the reason why the index finger is so free in its movements that we naturally use it as a pointer or beckoner. The two extensor tendons which go to it, though connected with each other, are not connected with the tendons passing to any of the other fingers, so that they act on it without influencing the movements of any of the other fingers. Hence its action is perfectly independent. But if we look at the extensor tendons which go to the middle, the ring, and the little fingers, for the purpose of straightening them, we shall find that they do not have a similar independent course, for they are all tied together on the back of the hand by distinct bands, which pass from the ring finger on the one side to the middle, and on the other side to the little finger. Hence you cannot work them in the same independent way that you can work the index digit, for in attempting to move one, the others are also acted on. Every one who has learnt to play a musical instrument knows perfectly well that he can strike a note with far more certainty with the index than with the other fingers, and that of all the digits the ring finger is the one over which it is most difficult to acquire control and mastery.

I will now give you an illustration of this which may perhaps amuse some of you, and relieve the tedium of the detail of anatomical structure which I have been giving you. Here are the five digits in each of my two hands. Now I am going to give to these digits names. I shall call my two thumbs father and son, and my two index fingers mother and daughter, my two little fingers brother and sister, and appropriately enough, my two ring fingers husband and wife. But I have got the middle fingers to give a name to, and I shall choose a name for them from that Parliament House in which you, Sir (the Chairman), are so distinguished an ornament. I shall select an eminent judge skilled in the law of husband and wife, namely, Lord Fraser. My two middle fingers, therefore, represent Lord Fraser. Now see what I am

going to do with them. I place the two thumbs in contact with each other at their tips, also the two indices, the two rings, and the two little fingers, and I bend the middle fingers down between the palms of my two hands. Then observe father and son I can part, mother and daughter I can part, brother and sister I can part, but husband and wife cannot be parted until Lord Fraser becomes visible. Put him on the bench, raise the middle fingers up from between the palms, and then the divorce of husband and wife—the separation of the ring fingers can be at once effected.

The widening of the hand by the separation of the fingers, and the bringing the fingers again into contact with each other are due to the action of muscles occupying the intervals between the metacarpal bones of the palm. But these movements can only be done when the fingers are straightened out or extended, not when they are bent on the palm.

The muscles which bend and extend the fingers, although possessing considerable power, have their action limited by certain conditions. Thus if we bend the wrist by the action of its proper flexors, we at the same time relax the flexors of the fingers, and if we then put the latter in action, we shall find that we cannot make a "fist," or forcibly bend the fingers on the palm, for from the position in which the flexor muscles have been placed by the bending of the wrist they have become so lax that their fullest action is not sufficient to tighten their tendons. Similarly, when the hand is bent backwards, it is almost impossible to straighten the fingers, as their extensor muscles are so relaxed that their power of extension is diminished.

Now I spoke of another important property of the hand, viz., its sensitiveness to touch. Let us look at the skin of the palm of the human hand, and we shall find that it has several very interesting characteristics. In the first place there are no hairs either on the palm or on the palmar surface of the digits. Secondly, we should notice its comparative smoothness and its tension. You may press upon it with your fingers but the skin of the palm does not slip to and fro, whereas the skin of the back of the hand, or on the body generally, can be moved about with ease. This tension is due to the skin being tied to the subjacent strong fascia by a number of intermediate bands. Through this tension

of the skin it can be accurately adapted to the surface of any object which is held in the hand, such as the globe or sphere that I am now grasping, and as the skin is the great sensory surface of the hand, the character and properties of objects, so far as they can be determined by the sense of touch, can be ascertained.

But there is another very interesting arrangement connected with the skin of the palm of the hand which I wish to refer to—that is, the presence of certain grooves on its surface. These grooves are of much interest in connection with the mobility of the hand, of which I have already spoken. For instance, the great groove that curves along the root of the thumb marks the movement of the thumb in connection with opposition, and where this groove is well displayed you may be perfectly sure that the thumb has a great range of movement. Two other grooves run across the palm of the hand more or less completely from one margin to another, beginning about the root of the index finger, and I wish you to note the direction which they take. They are inclined obliquely from the outer to the inner border of the palm, and there is no difficulty in seeing this in your own hands. They are grooves which mark the line of flexion or bending of the fingers on the palm, and their oblique direction indicates that the path of movement of the fingers in the act of flexion is obliquely towards the thumb. Another groove never so distinctly marked, as those I have just referred to, runs from about the root of the little finger towards the wrist. In some hands you will scarcely see it, but in others it is visible. It marks that movement of the little finger in opposition to the thumb, of which I have already spoken (p. 134). There are other faintly marked longitudinal grooves which extend from the roots of the fingers towards the wrist, which are to be associated with the movements of separation and approximation of the fingers referred to on page 137, and on the palmar surface both of the fingers and thumb are grooves, some of which are transverse and others oblique, which mark the lines of bending of the phalangeal joints of these digits. The signification of these grooves is to express the direction of movement of the various digits.

But there are persons who will tell you that these grooves

have a much deeper signification. If those persons were merely those somewhat swarthy-skinned, black-eyed, black-haired women who go about in the garb of gypsies telling fortunes, I should not refer to them now. But men purporting to be scientific have written books on the subject, which they dignify by the name of Cheiromancy or the Science of Palmistry. They state that by a proper study of these grooves and of the intermediate eminences, they can not only determine the character of people, but also foretell what will happen to them in the future. The groove which curves round the root of the thumb and marks the movement of opposition of the thumb they speak of as the line of life. The two grooves that run across the palm, which mark the direction of flexion of the fingers, they call the one the line of the head, and the other the line of the heart. The fine groove that indicates the movement of opposition of the little finger is called the line of the liver, and the groove which passes down from the middle finger to the wrist, and which is associated with the approximation of the fingers, is called the line of fate. Then the various eminences which lie between these grooves have all received names culled from the old heathen mythology. The eminence formed by the muscles of the ball of the thumb is called "the Mount of Venus," and that which marks the position of certain muscles of the little finger is called "the Mount of Mars" in one part, and in another "the Mount of the Moon," whilst the eminences at the roots of the fingers are named after Jupiter, Saturn, Apollo, and Mercury. But the study of the structure and movements of the hand at once dispels the cloud of mystery and superstition which some have endeavoured to throw over these markings, and resolves them into arrangements which are conditioned by the structural and functional relations of the organ in which they are found.

In addition to the strong grooves just described, a number of finer lines and grooves are present on the skin of the hand, more especially at the tips of the fingers and thumb, which are more distinctly seen with the aid of a simple magnifying glass. They express the position of what are called the papillæ of the skin. But these papillæ do not come to the actual surface, for they are all protected by an important envelope, which lies on the surface

of the skin, and is known by the name of the cuticle, or epidermis, or scarf skin. The cuticle consists of a very large number of small microscopic objects, technically called cells, which are arranged in numerous layers; those next the surface are tough and horny, but those more deeply placed are soft and contain the colouring matter of the skin. The cuticle is quite insensible and without blood-vessels, so that you may prick or cut it without giving pain or shedding blood. Here is a good specimen which consists of the cuticle removed from the human hand, forming, as it were, a natural glove. And this cuticle has no sensibility whatsoever.

The sensibility of the skin resides in that structure which is situated directly subjacent to the cuticle, that is to say, in the cutis or true skin which is composed of the elongated structures called papillæ. These papillæ contain both nerves and blood-vessels, and when cut they both bleed and give much pain. For the nerves which go to the hand terminate in these papillæ, in very remarkable structures, technically known as the touch corpuscles in the papillæ of the cutis. When you take and grasp an object in the hand it is brought, of course, into direct contact with the insensitive cuticle, but by slight pressure upon the object the nerves which end in these touch corpuscles in the papillæ of the cutis are, as it were, impressed by this object, and impulses are generated in the nerve fibres that end in the touch corpuscles, which are transmitted to the brain of the person holding the object, so as to induce in it effects which enable him to determine the form or the nature of the object—whether it be rough or smooth, sharp or blunt, cold or hot. In this way one is enabled to make out the various characteristics of material objects so far as they can be determined by the sense of touch. The most sensitive parts of the hand are the tips of the fingers and of the thumb. But if these very sensitive papillæ of the cutis were not covered over by the thickness of cuticle it would be entirely impossible for us to touch anything. The cutis is itself so sensitive that it is impossible to touch anything directly with it without occasioning very great pain. It requires, therefore, to be covered by a substance which is insensitive, so that we may use our hands as organs of touch. Persons who are accustomed to hard

manual labour, or to handle very hot objects, find that the cuticle undergoes a natural thickening. We all know the expression, "hard-handed sons of toil," which is not figurative, but expresses an actual anatomical condition. Why the sons of toil are hard handed is because their cuticle is very much thicker and tougher than it is in the hands of persons who have not to employ themselves in hard manual labour. This thickening is for protective purposes, and enables the skin to be used for the work which it has to do, without damage to the sensitive parts which lie beneath. The thickened cuticle, without doubt, diminishes the sensitiveness of the hand, but if a person ceases to use his hand in hard labour, then as the layers of the cuticle which lie next the surface are constantly being shed, it again becomes thinner and the natural sensitiveness of the hand is restored.

I had intended to have said something to you respecting the hand of the ape as compared with the hand of man, but as time is running on my remarks on this matter must necessarily be brief. In the hand of the ape the thumb is much smaller in size, relatively speaking, than the fingers. The ape therefore does not possess such power of opposition with its thumb as in the human hand, and therefore the ape's hand is not so efficient a grasping instrument. For example, in this skeleton of the hand of an ape, namely the orang, the thumb is a feeble digit as compared with the fingers, which are not only very much longer, but also stronger; and it is quite clear that this ape must use its fingers much more than its thumb in performing the uses to which its hand is put. If you take an opportunity of seeing, either in a zoological garden or in a travelling menagerie, the way in which apes use their hands you will find that they do not use the thumb to the same extent that a man does. When they grasp an object they encircle it with their long fingers, which are admirably adapted for seizing hold of and embracing the cylindrical boughs of the trees, which are the natural home of the ape. Further, the entire upper limb of the ape is both longer and more powerful than the lower limb, and when suspended by its hands it can swing itself from one bough of a tree to another, or can support its body with the knuckles resting upon the ground. This limb therefore is also used by the ape for progression, and the hand is a hand-foot or manuped.

But the skin of the palm of the ape's hand possesses grooves on the surface which mark the direction of movement of its digits. In the palm of the hand of the gorilla a groove corresponding to the upper of the two oblique grooves in the human palm crosses the palm from about the root of the index finger to the opposite side of the hand; its direction is slightly oblique, but without the marked obliquity of the corresponding groove in the human palm. A little below it is a second groove almost transverse in direction, whilst much nearer the wrist is a third groove running nearly in a transverse line. The curved groove which corresponds to the root of the thumb is much less individualized than in the human hand. In the palm of the chimpanzee the two grooves which cross it are almost transverse in direction, and the groove which runs along the root of the thumb is feeble.

The almost transverse direction of the two palmar grooves indicates that the fingers, when bent, are not inclined obliquely to the thumb to the same extent as in the human hand. The comparative feebleness of the thumb and of its movements are also expressed by the feebleness of the curved groove along its root. In these and other apes, therefore, the power of opposing both the thumb to the fingers and the fingers to the thumb is much less perfect than in the human hand, and the thumb does not play the same part in prehension. An ape grasps an object, like the branch of a tree, by enclosing it with its comparatively long fingers, which hook around it, and the movements of which are more adapted for grasping a cylinder than a sphere.

I wanted to have said something to you about the Foot in man, in order to show how it is adapted for the purposes that it has to perform, as an instrument of support and progression, but the time at my disposal will only enable me briefly to direct your attention to some of its principal characters. The human foot forms a base or pedestal to the very important column formed by the lower limb. And it is so constructed that it can support not only the lower limb but the weight of the entire body, either in the act of standing or of walking. The human foot is as characteristic of man as the human hand, and its most distinctive feature is the great toe. The great toe has the distinguishing

name of *hallux*, and the little toe is specially so called from its small size, but they are the only digits in the foot which have distinctive names. The great toe is by far the most massive in size and proportions. It lies parallel to the other toes, is continuous with the inner border of the foot, and does not project at an angle as does the thumb from the side of the hand. It also lies in the principal axis of movement of the foot. It is often the longest of the toes, though sculptors usually represent the second toe as the longest.

The foot in its general constitution corresponds in many respects with the hand. It has, however, only twenty-six instead of twenty-seven bones, which are arranged in three groups, viz. : the bones of the ankle or tarsus, seven in number; the five bones which form a large part of the sole or metatarsus, and the fourteen phalangeal bones of the toes. Like the hand it has five digits, and is pentadactylous.

The foot is situated at a right angle to the leg, and it is so arranged that the sole of the foot is directed towards the ground, so that the human foot is a plantigrade foot. But as the sole is not flat, but arched, it touches the ground only at certain points, viz., at the heel behind and at the heads of the metatarsal bones, more especially that of the great toe in front, and at these points the skin is thickly padded with a cushion of fat so as to diminish the pressure. In some persons the sole is flat, so that the greater part of its surface rests on the ground, but this is a deformed condition of the human foot, and one which diminishes its spring and usefulness. The arch of the foot extends partly from side to side, but much more markedly from toes to heel, so as to form a very considerable arch, which is always better seen on the inside than on the outside of the foot. Most of you doubtless know the expression, "a high instep." Many people think that this is a mark of high breeding, and undoubtedly it marks a well-formed and thoroughly useful foot.

The foot, like the hand, possesses flexibility, elasticity, mobility, and sensitiveness to touch. Its elasticity is one of its most important properties, for the foot even more than the hand requires to be elastic. It acquires a certain measure of elasticity from the number of bones and joints which it contains, just as the hand

does. But its arched construction adds most materially to its elasticity. The elasticity is required for two reasons, partly to aid in supporting weight, and partly to break shock.

When we are standing erect either on one foot or both feet the superincumbent weight of the body and lower limb is transmitted downwards through the larger bone of the leg (tibia) to the dice-shaped bone (astragalus), which is the highest bone of the ankle. From the astragalus the weight is distributed in two directions: directly downwards through the heel bone (os calcis) to the tip of the heel behind, and downwards and forwards through the bones of the inner border of the foot to the great toe in front. Now the principal arch of the foot, as I have already stated, extends longitudinally from the heel to the great toe, and the weight is therefore largely sustained by that arch, which is strengthened by strong ligaments passing between the different bones, and by some of the tendons which pass from the bones of the leg to the tarsal bones, and which act as slings. The prominence of the heel bone, which forms the pier on which the foot rests behind, is situated a little behind the centre of gravity of the leg and behind the axis of movement of the ankle; whereas in the fashionable ladies' boot of the present day, the high and narrow heel is moved forward so as to underlie the arch of the foot instead of being in its proper place below the pier of the arch itself. From the height and wrong position of the heel of the foot, a great strain is thrown upon the joints of the foot, too large a proportion of the weight of the body is thrown forward on the toes, and the usefulness of the limb is impaired.

The foot is far more liable to concussion than the hand. It is only occasionally that we drive a blow at a hard object with the hand, but we are constantly striking the hard ground with the feet, when we are walking, running, and leaping. In order to preserve the body from concussion it is necessary that those parts of the lower limbs which come in contact with the ground should have such an elastic construction as I have been referring to. In leaping from a height it is important to alight on the toes, and not on the heels. If the heel first comes to the ground, then the concussion is at once transmitted through the bones of the leg and thigh to the trunk and head, and great shock and injury may

accrue. But if the toes are the first to touch the ground the concussion is transmitted through the joints of the toes and of the tarsus, and is broken by the elastic cartilages and elastic ligaments which enter into their construction.

The mobility of the foot is to be considered both with reference to the entire foot and to the toes. The entire foot moves at the ankle joint in flexion and extension. We extend the foot in the act of walking by the action of the great muscles of the calf of the leg, which are attached by a strong tendon, named after the Greek hero Achilles, into the prominence of the heel. This movement is necessary in order to "take a step," and it is by it that the toes are pressed on the ground and the body is propelled forwards. The lateral movement at the ankle joint is almost inappreciable, as it is necessary that the joint should be fixed when we are standing in order that the erect attitude may be preserved.

The movements of the toes are not so interesting as those of the fingers and thumb, because they are far more limited. The great toe has, however, a considerable range of movement, though not so great as the thumb. It is tied to the other toes by a transverse ligament comparable to that which ties together the fingers, but which does not reach the thumb, and therefore its movements are necessarily very considerably restricted. Still we can bend the great toe and straighten it, and draw it away from and bring it back to the second toe. Similar movements, though even more restricted, can be performed by the other toes. By the approximation of the great to the second toe objects can be grasped firmly between them, but this is quite different from the movement of opposition of the thumb. Still persons who have had the misfortune to be born without arms or hands, or those who have lost them by accident in early life, can train themselves to hold and work with a pen, pencil, and even a knife or razor held between the sides of the great and second toes.

The skin of the sole of the human foot is marked by grooves which indicate the direction of movement of the toes, but these grooves are not so numerous or so distinct as in the hand, for the movements of the toes are neither so extensive nor so complicated as those of the thumb and fingers. To some slight extent there is a movement of the phalanges of the great toe towards the smaller

toes, and of these again towards the great toe, as is shown by the oblique direction of the grooves on the skin of the toes themselves. On the sole proper there are two somewhat oblique grooves near the inner border of the foot, at the root of the great toe, which indicate the direction in which the great toe bends at the joint between its phalanx and its metatarsal bone. Sometimes a longitudinal groove may be seen extending backwards towards the heel and beginning near the cleft between the great and second toes. This groove indicates the movements of the great toe in the transverse plane of the foot, as we separate it from or approximate it to the second toe. It is probable that persons who do not clothe the feet with shoes, and in whom therefore the movements of the toes are much more free, may have the grooves on the sole more distinctly marked, than is the case where the toes have been hampered in their movements and too often deformed through wearing tight and ill-constructed shoes.*

Let us now glance at the foot of the ape, in which we shall see that the great toe is set at an angle to the inner border of the foot. It is usually more massive than any of the other toes, but it is much shorter, and its general appearance is more like a thumb than a great toe. The skin of the sole in the gorilla possesses a strong curved groove coursing round the root of the great toe and running backwards towards the heel, which expresses the direction of the movement of opposition of which this digit is capable. In front of this groove are two well-marked grooves on the sole, which run very obliquely from near the root of the second toe to the outer border of the foot. Their obliquity indicates that the four outer toes, when bent, incline towards the great toe, and thus, like the fingers in the human hand, they contribute to the efficiency of the foot as a grasping instrument. A somewhat similar arrangement of grooves exists in the skin of the sole of the chimpanzee. So that in these anthropoid apes the prehensile character of the foot can be determined by an inspection of the skin of the sole, as well as by the study of the bones, joints, and muscles. The foot of the ape, physiologically speaking, is a foot-

* I have not thought it necessary to go into the deformities of the foot produced in this way, as this subject was treated by Dr Cunningham in his Lecture on "The Human Body," delivered in 1881 to this Society.

hand, it is pedimanous, *i.e.*, it can be used both for support, progression, and for prehension, whilst anatomically it is a foot, for it consists of bones and other parts similar to those present in the human foot. The power possessed by apes of using both hands and feet as grasping instruments has induced naturalists to say that they are quadrumanous.

A few words may now be said on the sensibility of the foot, because the foot is sensitive to impressions of touch, though not quite so sensitive as the hand. For the cuticle of the sole is always thicker than that of the palm, and this interferes, to some extent, with the transmission of impressions to the nerves which end in the papillæ of the true skin. If you were to strip off the cuticle of the foot, you would find it to form, as it were, a natural slipper similar to the natural glove I have already spoken of in the hand, and you would then see how much thicker the cuticle of the foot is than that of the hand, because the foot being used for support and progression, and subjected, therefore, to frequent pressure, requires a thicker cuticle in order that the highly sensitive nerve papillæ which are found in its true skin may be protected from injury. This sensitiveness of the skin of the foot is of great importance to us, because it enables us to determine the nature of the surface on which we walk. If the foot were not sensitive we could not tell the form or estimate the resistance of the surface on which the feet were placed in the act of progression.

A very interesting lesson may be learnt by watching the movements of a person who has no sensation in his lower limbs. For you sometimes find people who have a paralysis of sensation, and if you watch them as they walk, you will find that they look constantly at their feet, for through the want of sensibility they cannot estimate where their feet are placed. Persons so affected have to call in the aid of another sense, viz., that of sight, in order to enable them to tell what they are walking on. Should they be required to walk in the dark then they are helpless, because they cannot then employ the sense of sight to supply the place of that which they have unfortunately lost, namely, the sensibility of the skin of the soles of the feet.

From this rapid and necessarily imperfect sketch you will, I

think, have seen that in man the limbs are specialized for the performance of distinct and definite duties, and each limb is constructed so as to be adapted most efficiently to carry on the particular work which it has to do. The lower limb can be straightened at both the hip and the knee joints so as to be brought below the body, and the sole of the foot can then be so planted on the ground that we can stand either on one foot or on both feet. The spine can be elevated so that its axis becomes vertical, and the body assumes the erect attitude—that attitude which is characteristic of man. The head is balanced on the summit of the spine, and can be moved to and fro, so that the eyes exercise a wide range of vision. Within the head is a brain, far more highly organised than is possessed by any animal. The upper limbs, liberated from the necessity of acting as organs of support and progression, can minister to an intelligent mind, and through their strength and adaptability, can enable man to fulfil the great command which was imposed upon him in the beginning, to "go forth over the earth and subdue it, and to have dominion over the fish of the sea, over the fowl of the air, and over every living thing that moveth upon the earth."

THE DIFFICULTIES OF HEALTH REFORMERS.

PART I.

By H. H. ALMOND, M.A., Oxon.,
Headmaster of Loretto School.

"Difficulties are opportunities" is perhaps the latest addition to the aphorisms of the language. But since the kindness of the Committee has vouchsafed to me the present opportunity, I have felt with increasing and well-nigh overwhelming force that the converse is true, and that opportunities are also difficulties.

The task, indeed, which I have been rash enough to undertake is one which rivals in extent the far-famed unfinished work of Mr Caxton, on the "History of Human Error." Anything like an exhaustive discussion of my subject would involve not only a survey of the whole field of sanitary science, but also the consideration of a vast mass of outlying questions, which are entangled with social arrangements and institutions of every kind.

It has seemed to me, indeed, that the time has come when a new science ought to be formulated, which, after the analogy of the old political economy, should be called hygienic economy. Just as political economy demonstrates how all institutions should be regulated so as to produce the greatest amount of *wealth*, so hygienic economy would demonstrate how they should be regulated with a sole view to *health*. And here lies the root both of error and misapprehension, of error on the part of the investigator, because he is apt to regard the end which he has in view as of inordinate importance in the scale of human good, and of misapprehension on the part of others, because the conclusions arrived at will be continually clashing

with their preconceived notions. And yet this is surely the way in which the goal of truth has in the end always been won. Wealth is not the only good, neither is health. And yet as the one-sided conclusions of the political economist have been productive of vast practical good, though they have had to be balanced by other considerations, so it would clear, though it might startle men's minds, if for a time they could be led to contemplate all their institutions and habits in the light of hygienic economy, leaving the balance to be struck afterwards, as in the other case. I wish, therefore, to be understood to-night as rather putting the case of an advocate than presuming to give judicial decisions, for which I am unqualified, and which indeed would be premature. Health reformers—or, if you will let me use the word, Hygienic Economists—have an uphill battle to fight. Their science is in the condition of political economy, when commerce was fettered by restrictions and corrupted by bounties, when parliaments and statesmen ignored the scientifically proved laws of wages and prices, of demand and supply. And yet I venture to prophesy that the most advanced health reformer of the present day will appear to our grandchildren as a very narrow Conservative, even if he stands convicted of some of the blunders inseparable from all enthusiasm and from all search after truth. But let us consider if there is anything in the nature of hygiene to cause it to lag behind in the race of progress.

In the circle of the sciences it occupies the opposite pole to mathematics. So long as the science of mathematics dealt with pure abstractions, she escaped the persecution of bigots and the ridicule of fools. But when she came down and meddled with material things, when she rounded off the flat earth, when she bade the cramped heavens break open to their highest, then the slumbering forces of intolerance awoke, and forewarned her sister sciences that they too must pass through the purgatory of tribulation to the paradise of triumph. Each in her turn has suffered: each has won her way inch by inch. The progress of science is indeed a dark page in human history. The more any discovery has touched the prejudices, the passions, the narrow interests of men, the greater has been the suffering, the harder

the fight. But it is a bright page in human history for all who trust that

> "Through the ages one increasing purpose runs,
> And the thoughts of men are widened with the process of the suns;"

for all who see, in those who for the love of truth and for the love of men have braved all that men could do or say, a forecast of what humanity may become. They have not fought and suffered in vain. Our battle is practically won along the line. Opinion is well-nigh free. She has claimed and won her rights in the council chambers of nations, in the assembly halls of divines, in the daily speech and writing of men among men.

But—and here is the central difficulty of my subject—action is still fettered. Practice is not yet the necessary consequence of proof, and hygiene deals with action and with practice. She lies, as I said, at the opposite pole from mathematics. She may indeed draw her inspiration from above, but her home and her work are on the ground. There she is omnipotent and irrepressible. Like Socrates she brings down philosophy from heaven to earth, and also like Socrates she turns that philosophy into a weapon of attack against the strongest positions in which human error can entrench itself. Her aims, so vast in their totality, founded as they are on eternal principles of truth, necessitate for their realization a descent into details so petty as to incur the sneer of the apostles of culture, and notions so unconventional as to expose her on every side to the dislike and the derision of the vulgar rich and the vulgar poor.

Whenever she attempts to carry theory into practice she displays a combination of qualities which men in general loath and ridicule. She is meddlesome, prying, lecturing, and newfangled, especially in those matters which men regard as the sphere of custom and common sense, and in which they most pride themselves as being their own masters and taking their own way.

It will, I think, be clear from this why the main difficulties of hygiene are essentially different from those of the other sciences, even those who deal most closely with life. Their difficulties are mainly those of research and discovery. No one, *e.g.*, can doubt that if the problem of producing a cheap and manageable electric

light were solved (or if an electric locomotive were invented, having a distinct balance of advantage over the steam-engine), that the universal adoption of such an improvement would be a mere matter of time, and whatever might have been the case 100 years ago men will not be deterred by the novelty of the thing from committing themselves to the guidance of aeronauts, if a machine can be made to fly quickly and safely against the wind.

This holds even in the science which is most closely allied to hygiene, viz., medicine. The exact line between the two is indeed at some points difficult to draw, and I certainly shall not attempt the task. But speaking generally, an alleged discovery in medicine gets a free hearing and a fair trial, and if it makes its claim good it will certainly be carried out in practice. The opposition to the use of anæsthetics—and some will think that I ought to specify still later outbreaks of fanaticism—was a survival of a noxious species of human error, happily so moribund that it will soon become impossible to catch a specimen for vivisection. But it is not so with hygiene. Here discovery is far in advance of application. The field of further research is indeed practically unlimited. But it is not too much to say that if what is already discovered could be realized in practice, though that day must be far distant, the face of society would be transformed. Why is this so? Why does practice not follow recognised truth in hygiene? I think mainly from two causes distinct in themselves, but often allied in doing their evil work. The first is indifference, bred partly of ignorance, partly of selfishness, partly of indolence. The second is the gigantic force of custom or fashion. Now I am fully conscious that any illustrations of these tendencies must seem individually insignificant, and insufficient to warrant such sweeping conclusions as I endeavour to draw. But I must entreat you to bear in mind that proof which is essentially cumulative in its nature must necessarily seem feeble in brief and incomplete detail; and I am sure that if any one will get into the mental habit of asking himself about all matters public or private, all arrangements however matter of course, all customs however firmly rooted, what are their hygienic bearings, that he will

more than confirm for himself any proof which I can offer here.

The first cause which militates against the practical adoption of known hygienic truth is that of *indifference*, and it is to the operation of this cause that these lectures will be mainly devoted.

It is not only the health reformer who has to encounter this. To the advocate of political reform, or, as I have shown, of speculative or scientific progress in general, it no longer presents a formidable front, but it is otherwise, I fear, with the preacher of righteousness. It is not that he fails to prove that his counsels are for the good and happiness of men as that there are other forces more potent over their wills than reason and conscience. But to-night I wish to be as little as possible a preacher. Other gentlemen who have addressed you have made earnest and vigorous assaults on particular positions of the enemy, whereas I seem to myself rather like the typical Irishman, who in a moment of evening excitement imagines himself at Donnybrook fair, and flourishes his shillelagh impartially among the heads of a peaceable crowd who are wishing for nothing so much as a quiet life. But I can imagine some one saying, "Surely this is an uncalled for display of energy. These quiet people whom you threaten to belabour will only be too glad to listen to anything you have to say on the savoury subject of drains, traps, and ventilating pipes, and to undergo any reasonable amount of expense and annoyance to themselves and their neighbours in carrying out your ideas—if you have got any, and they think them good ones. And as to water, why if you can make out a case against our present supply, and show that it possesses the noxious properties and contains the interesting forms of animal life, which were once supposed to characterise the water of St Mary's Loch, so far from your shillelagh performances being confined to yourself, we will promise you a general free fight to your heart's content." Well, ladies and gentlemen, I thankfully admit all this; and further, that the public conscience is beginning to awake to the fact that spreading infection, or (from mistaken ideas about personal liberty) allowing cases of infectious fever to remain where they cause danger to others, involves guilt of the same nature as

firing loaded guns haphazard in a populous neighbourhood; and, again, that the pollution of rivers and the frightful waste of fertilising materials caused by carrying town drains down to the sea, though for a time perhaps necessary evils, are fully admitted to be such, and that any feasible plan for putting an end to them will be gladly welcomed and in the end carried out.

I fear, however, that my imaginary objector would represent a wide-spread feeling of self-complacency; because in such matters as these, this generation *is* much more enlightened than our forefathers, and there is no doubt of the vast measurable effects of this enlightenment: the death rate has decreased, and the war against pestilence and fevers is being carried on with ever increasing success.

But if every house in the kingdom were guaranteed against the entrance of sewage gases and supplied with the purest water, the hardest battles of true health reform would still have to be fought. The age may plume itself on being liberal, and so long as progress goes on on recognised lines it *is* liberal; but when a new departure has to be taken, it will be the old story over again. Now please mark this distinction, for it is an important one. Sanitary science is advancing by leaps and bounds, so far as it deals with the surroundings of man, but the wet blanket of indifference is thrown over its most clearly proved truths when they relate to his institutions and habits.

Let me first take a subject which is on the borderland of this division—the subject of *ventilation*. It has certainly to do with man's surroundings, but it is intimately connected with his habits, because good ventilation is repugnant to those who do not lead wholesome lives. Pardon my saying it, but most of of you are probably too accustomed to rooms habitually overheated (hydropathics, *e.g.*, advertise a temperature of over 60°,* which is too great a contrast to the outside temperature in winter). You are also sensitive, because you are too indifferent about taking exercise, and also from the custom, far too deeply

* In America a much higher indoor temperature is kept up. And this fact has probably far more to do than climate has with that physical deterioration about which Americans are justly becoming alarmed.

engrained to be within the range of practical reform, of always having the head covered when out of doors, and uncovered when within doors. On this point I may mention that I looked in vain through the evidence about the blue coat schools given to a Royal Commission. It is a striking illustration of prevailing indifference on such matters, that not a question was asked as to the effect of bareheadedness. But from my own experience I can assert that boys who are usually bareheaded when out of doors can stand a greater amount of ventilation both in school-rooms and in sleeping-rooms than those who habitually wear head-coverings. From these and other causes, there is great practical indifference about the well-established principles of ventilation. Theatres are terrible offenders, churches are often nearly as bad. In how many of them, I wonder, are doors and windows freely flung open between morning and afternoon service? And how many clergymen or kirk sessions think much about the purity of the air in churches? I have heard of a church in the South of England where every aperture, including the keyholes, was stuffed up even during cleaning; and perhaps some of you noticed that the Crofter Commission did at least one tangible piece of good at Bunessan in Mull—they broke a church window, to enable them to breathe. As I remarked in a letter which the *Scotsman* kindly inserted, I wish they would do the like in every sacred reservoir of foul air in the country. And as to less sacred reservoirs, I hope that any representatives of a neighbouring seat of learning who are present will pardon my saying that I have heard strange tales about the state of the atmosphere in some of the University class-rooms, especially where the back benches rise towards the ceiling. I may have been wrongly informed. The known truths of ventilation may be so perfectly carried out and open windows so delighted in by both professors and students, that even the maximum of ·6 per 1000 of carbonic acid is never attained. If so, I apologise; I have been misinformed.

But as to schools, surely they at least ought both to teach and to practise plain and certain truths of science. Well, I have passed some buildings in Edinburgh, which I was told were

schools, and I could see no window open, even an inch at the top, nor any sign of overlapping window sashes produced by the simple and well-known expedient of a piece of board firmly fixed beneath the lower sash. And I saw announced in the gossip column of a school journal, as a piece of news, that a window had actually been seen open a few days ago!

And as member of a School Board, I have been nearly knocked down, not by the schoolmaster, but by the atmosphere, on entering a room after school hours, whereas all the doors and windows should be flung wide open after every hour. Now, I admit that the new Board schools are roomier and better ventilated than the schools which they superseded; but no patent ventilators can ever keep the air of crowded rooms as pure as it ought to be; and if we are to confine all the children of the nation for most of the daylight hours in winter, we should at least ensure that they breathe pure air. And here again we are complicated with other considerations. Why are so many clergymen and schoolmasters indifferent and unobservant about this? Why, because as divinity students or pupil teachers they have led too sedentary a life, and, in the latter case especially, they have half their vitality taken out of them by the excessive indoor work and confinement at an age when nature most resents such a violation of her laws. And, again, hygiene is not one of the subjects rewarded by the code. Physical morality is taught by no catechism, it holds a place in no articles or confession, or manuals of theology, though the laws of life and health are as much God's laws, as much binding, when known, upon conscience and upon practice, as if they had been thundered forth on Sinai. But I am anticipating.

The ventilation of the houses of the better class is perhaps tolerable, but what of those of the poor? Let me give you a remarkable instance of the indifference about which I am croaking. A year or two ago the fact was asserted on good evidence, and not denied, that consumption was greatly on the increase in the Highlands. They say that wise men write *for* newspapers, fools *to* them. I fear I am sometimes one of the fools. I wrote to the *Scotsman*. I suggested that the substitution of

slated houses and plastered roofs for loosely built thatched cottages had something to do with this. I happened to have summer quarters in a new slated house, fortunately unfinished. Had the attics been plastered, I don't see how any human being could have lived a night in them, and there are the bare rafters to this day. I live in the house every autumn. And there was only one skylight, and it wouldn't open, and some of the windows wouldn't open, others opened ever so little from the bottom. Well, I saw a good many of these slated houses. People said they were improvements, more civilised, and the like. Knowing as I did the ravages which consumption had been proved to cause among the Guards in London from bad ventilation, I didn't see how consumption could fail to arise under such conditions. I said so. Unfortunately I made some allusion in my letter—I forget how—to sea birds. To my consternation—I had dragged a red herring across the trail—a lively controversy arose about the birds; but when the vitality of a people was concerned,—and mark you the fact about the increase of consumption was never denied, whether true or not,—it was impossible to galvanise any public interest. Now I don't think that this was the only enfeebling cause at work in the Highlands, and discussion would have brought this out; but I fear that if the "Great Northern Diver" had been found breeding about a Sutherland Loch, more public interest would have been excited than it was possible to excite about the alleged deterioration of health in the Highlands. But there is light in the distance, as I hope to show you before I have done. Meanwhile I will pass on from the ventilation of buildings to the ventilation of towns by open spaces or lungs.

You must all know that the air of towns is not so pure as that of the country, and that the air of the crowded parts of large towns is injurious to those who constantly live in them. From this point of view the knocking down of what are called "rookeries," the opening of new streets, and the widening of old ones, has been of great benefit, and for much noble work of this nature Edinburgh can never forget the debt she owes to the memory of her great citizen, William Chambers. We must

also thankfully acknowledge the gifts of parks to towns by public-spirited men and women, like Miss Duthie and the late Sir David Baxter, though such gifts, as a whole, have been miserably disproportioned to the portentous growth and the crying needs of our great cities. But even with a sole view to ventilation, it is better to live in a well-ventilated house in the east of London than in an ill-ventilated house in the country; and the purity of the air in towns is a matter of secondary importance to the use made of open spaces and the general arrangements of their lives by dwellers in cities.

Those who sound most lustily the hallelujahs of modern progress seem to me wonderfully indifferent to the conditions of life in our towns. I am not speaking here of the seething mass of suffering and vice, the alleviation of which engages the earnest thoughts and efforts of increasing multitudes of philanthropists. This is not my subject, for though there is no doubt that all hygienic reform would co-operate in decreasing suffering and removing temptations to vice, such work must be mainly accomplished by other means.

But let us grant, for one instant, that these instrumentalities had done their work in a single city, that there did not remain within it a single wretch who hardly knew where to look for the next meal or the next night's shelter, a single child uncared for, a single criminal or unfortunate gaining his or her living from crime or vice, what would then be the destiny of its population, or rather of that part of it compelled by necessity, or induced by gain, constantly to reside and work within the buildings of that city under existing conditions; living, in fact, the lives which the great majority of our artizan, shopkeeping, mercantile, and professionl classes live at present? I will grant it perfect drainage, perfect water supply, and such ventilation as its habits will suffer to exist. But I will not grant that it shall be recruited from the population of country districts.

What will happen in a few generations? Very much the same thing which would happen to the Caspian Sea if the Volga no longer flowed into it. It would evaporate and gradually dry up. Well, this is a startling assertion. I am not going to trouble you

with many quotations, but please on this point allow me to quote from an article by Dr Cantlie, in Mr Morris' "Book of Health," pp. 394, 395.

"Examine the history of any of the leading men in almost any branch of industry in one of our large towns. Consider the parentage of such, and where they come from. How many of these men were born in the town in which they attained eminence? or perhaps it would be better to consider where their parents were born, and how they lived. The boy who becomes a lord mayor is always pictured as coming 'into' London from the country; and without drawing upon the imagination, let us consider the parentage of the lord mayors for the last thirty years. Of the number occupying the mayoralty during this time, twenty-five were either the children of parents who were importations to London, or themselves came into London at an early age. It is better to take these as examples, in preference to judges and politicians, &c., who, if born in towns, must almost of necessity have spent their youth at one of our universities or public schools, where, during the period of their youth, say up to seventeen or twenty, they have built up, under well-regulated mental and bodily exercise, a stronger frame, and started life with a better formed physique than the son of a townsman, who, trained in a city school enters an office at fourteen and pursues his calling forthwith. We find that the chances of such a lad attaining eminence are not great, and that of such stuff our greatest citizens are not made. Pursue the history of this town boy still further, and it will be found that the sedentary life inculcated, the close application, the hurried meals, the continual mental strain he undergoes whilst he is growing to manhood, are, in the face of them, but little calculated to engender the belief, even to a casual observer, that his children would be endowed with strong frames, or capable of much physical endurance. It is difficult—I will not say impossible—to find a third generation of pure Londoners, because the father or mother, a grandfather or grandmother is almost certain to prove to have been an importation into London, and the evidence forthwith breaks down. But it is doubtful if more than three generations are possible. We know

that in India the third generation of Europeans do not reach maturity, and there is but scant proof of pure Londoners continuing to four or five generations. The term pure Londoner is difficult to explain and limit. However, there are in London two millions of people whose parents have lived in London, whose sole knowledge of country air and scenes is gained, it may be, by an occasional bank holiday excursion. These are to be considered pure townsfolk ; and it is in this class that the effects of town life on the progeny show in the extreme. In this class it will be found that the third and fourth generations are puny, and that the children of these late generations seldom reach maturity. Not only is it true physically that a family or nation declines, but with the stunted frame is a brain that begets morbid thoughts, that engenders a weak mind, that allows the individual to be driven to rash deeds—a mind that knows no control, the owner of which becomes the slave of his morbid inclinations."

Perhaps, however, the species would gradually adapt itself to its conditions, and might fulfil the brilliant anticipations of Mr Kay Robinson in his recent article in the *Nineteenth Century*:—

"The man of the future therefore," he says, "will not only be toothless, baldheaded, and incapable of extended locomotion with his imperfectly developed feet, but he will also be particularly averse to engaging in personal conflict,—a lover of peace at any price."

But suppose we do not take so extreme a view, suppose we admit that the extinction of the city race, or the more dreadful alternative of becoming "men of the future," will be averted by the improved and improving conditions of life so far as surroundings are concerned, by the banishment of drunkenness and other vices, and by the increase of holidays, the whole evidence goes to show that the sedentary population of towns living its present life and unrecruited from the country would degenerate into a feeble nerveless race.

Well, the Volga keeps up the Caspian. But let us suppose that by a geological subsidence the basin of the Caspian was being continuously extended and that the Volga dwindled, what would happen then? Why, before long, the sea would resolve

itself into reeking salt marshes, unless the evaporation could be stopped.* And are you not aware that every census shows an enormous increase in the area of towns, and a tendency to decrease in that of the country population which keeps up the vitality of towns? Nor is this all. Owing to various causes, such as increased facilities of artificial locomotion, increased substitution of machinery for manual labour, increased indoor and luxurious habits of life, disastrous changes in diet, and the fatuous ignorance of much of our educational zeal (of which more anon), the remaining sources of this vitality are in the way of being seriously impaired. Such being some of the problems of the health reformer, you will not, I think, deny that his difficulties are serious, and that the amount of indifference which he has to overcome is great. But before further discussing them, let me so far clear the ground. It has been said, and often repeated, "God made the country, man made the town." I deny the antithesis. God made both. He made man to be gregarious. He has endowed him with faculties which can attain their full activity and perfection only in large civilised societies, and he has also endowed him with a slow-working but indomitable force, which shall bend all the difficulties which from time to time bar his upward progress into opportunities for getting nearer to that perfection of his entire nature for which we cannot doubt that he is destined. There is another potential "man of the future," whom I will back against Mr Kay Robinson's, large in heart and brain, wholesome in tastes, keen in sensibilities, powerful in body, glorious in development, loyal to nature in habits, and if health reform can have full swing for a single generation, that man shall be grown in our towns.

Now what are the inherent deficiencies of town life as it is? Drainage, water, ventilation, may all be set more or less right on our present lines, and in matters of diet and clothing, truth may after a long and constant struggle overcome man's most powerful and most subtle tyrant, the force of fashion or custom.

* I am, of course, aware that another difficulty—viz., the Malthusian—must here suggest itself to many minds, but it is not a problem of the immediate future, nor is this the place to discuss it.

But in one point, and that the most essential of all, there is need not of reform, but of revolution, and that is the point of exercise in pure air. Now it is not my business to give you the physiological and other proofs of this assertion. For these I refer you to previous lectures and health manuals, and especially to Dr Cantlie's article already referred to. Neither have I space here to meet the many side issues which must occur to most of you, but I will confine myself to the one impregnable statement, that the immense majority of our indoor workers have neither the place nor the time to take such exercise as is needful for most, if they are to be healthy themselves, and for all if they are to be progenitors of a healthy race, and I need scarcely say that, as physical labour of the natural or productive kind is not usually available for towns-people, they must have recourse to artificial substitutes, which do the same physiological good.

Now, walking along streets or roads may do for older people, but certainly for younger men the primæval law of our nature, "in the sweat of thy brow thou shalt eat bread," is not to be satisfied by a mile measured walk, even if busy men had time to get enough exercise out of mere walking, which they have not.

But for proper exercise, outdoor or even indoor, where is the place, where is the time? Let me give you an instance of the difficulty of finding a place for exercise in the present state of public feeling. Many years ago I was associated with Drs Cathcart and Burn-Murdoch in looking out for a cricket field for the University. We enquired about almost every suitable piece of ground within easy reach. We were treated everywhere with courtesy, but in no instance did it seem to strike any proprietor or agent, "This is an urgent necessity, we will do our best to meet you." Of course we had no right to expect a present, but the spirit in which we were met, and I know of similar instances elsewhere, appeared to be this—"You are eagerly desiring a scarce article, and we will get out of you what we can." I am afraid there wasn't much to get out of us. Had it not been for the exertions of the Principal, made as these were when his hands were as full as they could hold of other business, we could not have scraped together enough to start any field. We were driven at last to

ook along the lines of railway, and I daresay, after all, the field at Corstorphine suits its purpose as well as any we could have got. Now I felt keenly on this matter because I knew something about the needs of Scottish Universities. I was at Glasgow for five sessions, and at Oxford for four years. Now some people are accused of Anglicising, of going to English Universities and encouraging others to go there for unworthy reasons. I will tell you frankly how the case stands from my own experience. I never got better or more stimulating teaching than at Glasgow University, and only in one instance did I receive as good public teaching at Oxford. And the standard of an Arts degree at Glasgow is fully as high as that at Oxford. I think, also, that Glasgow produces very few, if any, of the most objectionable types of Oxford man—the prigs and the spendthrifts (though the latter class especially are rarer than is often supposed). But Glasgow produces one type abundantly which Oxford hardly produces at all, and which no University ever should produce—the pale, narrow-chested, worked-out student. That this should be so is the natural result of the life at the two places. Work and exercise, I need hardly say, ought nearly to fill up a student's life. The immediate work is generally the better for the exercise, and certainly well-aerated blood is necessary to build up a brain strong in energy and will-power for the work of future life. Do you suppose that, I will not say the literary ability, but the colossal brain force of the Prime Minister could have been built up but for the out-door training of Eton and Oxford, and the active habits which he has carried on to an age when most men are used-up valetudinarians? Well, what exercise was available at Glasgow? Walks without an object, with now and then perhaps a day's skating.* A few enthusiasts took to rowing on the Clyde. One of them was capsized, and as if an immersion in that mixture of fluids wasn't punishment enough, the poor fellow was pilloried in a Glasgow paper, much in the same way as the shinty players have been "pulpited" by a reverend gentleman in the North, for amusing himself when he ought to have been at his studies.

* There was not then that magnificent gymnasium, for which Glasgow is indebted to the exertions of Prof. Ramsay.

But at Oxford nearly every one, and the hard-reading men most regularly of all, was out of doors every afternoon, many on the river (I remember a Balliol eight which had at least six first classes on board), many, according to the season, cricketing, hunting, riding, water jumping, playing rackets, fives, &c.; football then was played very little. I hope you will let me say that I feel more indebted to the Oxford boating system than to any other single element in my own education.

Now pray don't suppose that I am not alive to the fact that exercise may be overdone, and that it may be made an end instead of a means. Empty heads, if the bodies they belong to take to athletics, are like other empty heads. The people who read nothing but sporting papers, who make "pot-hunting" a business, would perhaps be otherwise strutting along Princes Street or lounging at refreshment bars. And I don't see that it would be any improvement.

But to return to our Scottish Universities. It is unfortunate that the largest of them are in great cities. But can't we make their difficulties opportunities? Can there not be a big effort to give Edinburgh University a worthy Gymnasium? As Professor Butcher said in an address to the students: "If the Greeks had had to carry on their gymnastics in a cellar, they would not have done for us what they have done in literature."

And should it not have numerous open fives courts? Not racket courts, observe. Fives are a better and much cheaper exercise than rackets. There is no game which takes up so little space and gives so much exercise to all the limbs and to both sides of the body in so little time and at so little cost. Where, you may say, is the money to come from? Money! the money would come fast enough if people cared as much about a fine breed of men as they do about a fine breed of horses! Where, I may ask, did the £13,000 come from to vulgarise a noble crag, in the neighbourhood of Stirling, with a purposeless excrescence? And, ladies and gentlemen, I fear my words will be wasted, but they must come out. People have got £12,000 quite easily for a testimonial to a most respected nobleman. I know how hard it was to collect a much smaller number of thousands to prevent

the builder from laying his clutches on seventeen acres, now secured as open ground, at Raeburn Place. I hear they are going to make a statue with this £12,000. Perhaps the Buccleuch Gymnasium or the Buccleuch Park wouldn't sound as well as the Buccleuch Statue; but which would do the greater good, which would be the greater honour to the Duke? Think which would have done the greater honour to our national hero, to spend the £13,000 as it was spent near Stirling, or in doing something to rear up men like him, to combat the evils of our time as he combated the invader? Perhaps, however, the time has scarcely come for enunciating the strange doctrine that intellectual and physical education should be co-ordinate from the primary schools to the Universities. Yet in this, as in other cases, it may turn out that the paradox of the present will be the axiom of the future. But we have to do with the present, and if the appliances for due exercise are given to the students, and if they are addressed by their Professors as they were by Professor Butcher, I know they will use these appliances. I know that their *esprit de corps* will increase as it has been increasing. And then the University will do what it ought to do. It will not only teach science, but it will act science; the light of physiology will not be hid under the bushel of the class-room, but will shine far and wide for the illumination of life; it will lead the van in a revolutionary movement, which, as I have tried to show you, is essential to the vitality of the people of our cities, and of their children after them.

And what a city it has to lead—inhabited by a people of a hardy stock, with ennobling traditions, and rarely equalled natural advantages, not the least of which is that there is a great deal of ground about it which never can be built upon. Even an Athenian would, I think, envy you some of these advantages; but I am sure he would be surprised at the way in which some of them are neglected. Let us take the Meadows. Many years ago I used often to pass between the East and West Meadows, when the former were crowded with cricketers in summer and football players in winter. But there were boards up on the West Meadows stating that no games were allowed at present.

So there was an occasional pedestrian there and a few nursemaids and children, who all looked very solemn, and afraid to run about in case they should be taken up for playing games. It seemed to me as though I were in a land where food was scarce, and on the one hand were fields bright with harvest, but on the other were wantonly barren lands of the richest soil. For the crop growing on the one side and forbidden to grow on the other, was that on which the old Roman legend tells us that the greatness of a nation is based, its manhood. For as in the cornfield one can see as it were the rising sap, and the swelling ear, and the bursting grain, and bread for the hungry people, so here, no one who thought upon it could help seeing the pure air of heaven rushing at fourfold pace through the lungs of the indoor toiler, and the aërated blood coursing through his veins, clearing away noxious deposits, and building up the bone, and the muscles, and the nerves, and the healthy brain, and the strong will, and the buoyant energies which are the life and the power of nations. And one would thank God that there was widely spread among us the instinctive craving for such activity as I saw then. For no knowledge, and no wealth, and no "silver streak" can save the island of crowded cities when her manhood shall be gone. Well, years have passed by, and what has become of the Meadows? In summer there is a rather stunted crop growing (after a vigorous attempt to root it up) on the West Meadows, for if I am rightly informed, no roller is by the laws of our city agriculture allowed to be put upon that enclosure. On the East Meadows there is no crop at all, and in winter there is a small crowded crop at Stockbridge, a place too remote to be of any practical use to the old town. But the Meadows, East and West, forcibly realize the text, "A fruitful land maketh He barren for the wickedness of those that dwell therein." Yes, my friends, it is not the fault of the Town Council, it is your own. Do you make this a vital question at municipal elections? Has it ever turned the scale for any candidate? and do you expect all the Council to be like our chairman unless the question is raised at elections. Remember the argument is all on one side. Our foe is a Parthian foe. It wont come up to the scratch. It

wont discuss. It now and then sends a stray shot which doesn't hit. For instance, they say that any games, *i.e.*, anything but a solemn walk on the Meadows, are dangerous. Now I hope I have showed you that there is a danger in inactivity which compared with that of any game is as consumption to a cut finger. But the argument of danger irresistibly reminds me of what happened when some Englishmen started cricket at Riga in Russia. Being told it was a dangerous game, the authorities sent a policeman to see for himself and report. Anxious to be accurate in his statements, he persisted in standing at the place of a near point. Quite unintentionally he fielded a ball with his head, and his skull not being so thick as the skulls of the people who sent him there, he was hurt. And so the game was stopped by the authorities. Now this is a fact.

There is another case, however, which for absurdity and unreasonableness, throws the case of the Meadows in shade. Having games played on the Meadows would certainly prevent a number of people from using short cuts, and add a few hundred yards to their daily walk. Considering that probably not one in ten of these people takes nearly enough exercise, there would be no great evil in this; but we can scarcely expect the sedentary business men who predominate in the Council to look at football as a means of health rather than as a rough and dangerous amusement for which they have no personal predilections. But would that the Council were supreme all round the city! Scotchmen may make mistakes, but they mean, according to their lights, to do what is for the good of Scotchmen. If you want an example of obstinate recklessness and ignorance in dealing with Scottish interests, you have to find some instance in which their interests are dealt with by an English board or department. Unfortunately the Queen's Park is under the Board of Works. A petition was sent to the Board with the unanimous assent of the Town Council, and signed by 4500 citizens of Edinburgh, to ask leave for the football players to use a piece of the Queen's Park, near Holyrood, when not needed for drilling purposes. The petition was sent in May. In August the reply was received, "That having carefully considered the matter, the Board regret that they are unable to

set aside a portion of Holyrood Park as a recreation ground for football and other games." No reason was assigned. But on August 10th, in reply to a question by Lord Rosebery in the House of Lords, Lord Thurlow said, "That granting the request of the Edinburgh petitioners for said purpose would be inconsistent with the general enjoyment of the ground by the public." Now some people have been anxious to ascertain the nature and extent of this enjoyment, and so a watcher has been on the ground for the last four Saturdays from 2 P.M. till dusk. As you know, they have been fairly fine days. It has been found that the ground is used for two purposes. There is a path over it which saves anyone going towards St Margaret's Loch about, I believe, 100 yards. The total number of persons lessening their daily exercise by this amount on the four Saturdays has been 107, more than half of whom have been children going to sail boats and play about St Margaret's Loch. This has been the first purpose observed; the second is rather curious. On one Saturday four persons for some time derived a peculiar, and no doubt intense, enjoyment from the ground. They were boys, and their enjoyment consisted in taking successive draws at one cutty pipe.

I passed the ground to-day. It is a muddy, melancholy flat. What form of enjoyment any of the public could derive from it, except taking a short cut, and smoking cutty pipes, &c., when the terraces and slopes of Arthur Seat are close at hand, it is impossible to conceive.

Again, why are there no large public swimming baths in the old town of Edinburgh? Why had a private company to try three times before they got the money, about half a "statue," to start the Drumsheugh Baths? Why are not several "statues" subscribed to keep ground open near the city? For, depend upon it, an enlightened generation will at a vast sacrifice pull down where we are building up. Why is there not one open fives-court in Edinburgh? and only one or two gymnasia, and one of these in a cellar? Why, on the few occasions in which skating is available,—an exercise which makes a crop of vigour to grow like Jonah's gourd,—is the forming ice on the two nearest lochs allowed to be smashed by thoughtless boys, all for

want of a watcher or two? Why can't the public or rich private persons pay the canal company a fair compensation to stop their ice boat? Why are no artificial slides made in proper places for boys and children, as might easily be done?

Another matter has been brought before my notice since this lecture has been in type.

At a meeting of the Governors of Heriot's Hospital the other day, two of our city clergy advocated the formation of a bowling green in the Hospital grounds for the working classes. Now bowls is to the elderly working man what golf is to the lawyer. It would mean health and life to many.

Three objections were raised by different speakers,—1st, Where was the money (about the sixtieth part of a "statue") to be found? 2nd, That the thing was "so absurd." 3rd, That they might require to build on the Hospital grounds.

I think I have merely to state these objections to prove my contention that they show an astounding indifference to the elementary facts of physiology, and to the needs of our great cities.

And why don't you make more use of the Pentlands? Road walking is a poor sort of exercise, but hill walking both for the climbing and for the strong air is a very good one. Are some paths shut up? Why were they shut up? Why, because you didn't use the Pentlands. I know you didn't, for I have been over them again and again in every direction, and scarcely ever met a soul; and so long as there is no law of trespass (provided no damage is done) I shall go over any open ground I please; and if such a law were in operation, I should be tempted to become a Radical on the Land Question. For there is not another country in the world which shuts up its mountain land as some people have most audaciously and most unpatriotically attempted to shut up vast tracts of the Highlands, chiefly for the lounging, sneaking, murderous mockery of sport called deer-driving,* and to the injury of healthy sport, and of other things which do the same sort of good as sport, the pursuits of the naturalist, the artist, and the mountain climber.

* A very different thing from the noble sport of deer-stalking.

Now why don't you use the Pentlands? I think that some public spirited proprietors must have held a meeting, and resolved to call you to a sense of your neglected opportunities, and to put your backs up (as the phrase is) by shutting up old paths. There couldn't be any other reason. They could scarcely hope to keep them shut, could they? And, thanks to some of your fellow citizens, I trust they cannot keep them shut, and they certainly shall not shut up the hill sides, and I hope the result of it all will be that more of you will see the view from the top of Carnethy than ever saw it before.

But where is the time to come from for all this exercise? This is a very difficult question to answer, and I have taken up so much of your time already that I shan't enter upon it now. But pray don't think there is no way out of this difficulty, or out of most difficulties. The Committee have kindly allowed me to cut this lecture into two. Next Saturday I shall try to answer this question, and to point out other instances of indifference in connection with food, and with a subject which has lately caused great and justifiable alarm, viz., the demands of modern education, in defiance of physiology and of common sense, on the immature brain. I purpose next to discuss the difficulties caused by the gigantic force of custom or fashion; and I shall conclude by briefly indicating (for the subject would require a lecture to itself) the means by which the laws of God, made known to us by science as affecting man's health and well-being, may be gradually recognised as laws which we are intended to obey, may become an essential part of the ground-work of education, may be bound up with the fundamental principles of morality and religion, and may at last, by that riper civilization which we may see afar off, though we may not enter into it ourselves, be realized in practice.

THE DIFFICULTIES OF HEALTH REFORMERS.

PART II.

By H. H. ALMOND, M.A., Oxon.,
Headmaster of Loretto School.

I left off the last lecture in the presence of a serious difficulty—Where are indoor workers to find the time for outdoor exercise? Before attempting to answer this question let me briefly sum up the grounds for believing the subject to be one of grave importance.

I showed last Saturday that there is reason to believe as a matter of fact, that such a thing as a fourth generation of pure Londoners scarcely exists. But even if this statement is questioned, there can, I think, be no doubt that, under modern circumstances, indoor city workers, leading the lives which most of them lead, do as a race, unless recruited from a healthier stock, tend to degenerate, if not to disappear. And as a matter of theory there can be no doubt that physical labour, for one sex at least, is a physiological necessity for a thoroughly robust individual, and that the degeneration of a sedentary race might be predicted, even if it were not established as a fact.

I am the more anxious to make this clear, because it is a thing which is very little thought of, and which is the cause of disastrous practical mistakes.

I have heard successful lawyers and men of business refer to their own careers in an aggrieved and desponding spirit, because there was no sign of its being emulated by their sons. They tell how they entered an office at fourteen or fifteen years of age; how they worked all day, and often far into the night; how, except on rare holidays, they got no outdoor exercise (which they would probably call "play") to speak of, and there they were, and why should not their boys do as their fathers had done. And

I have sometimes been told the axiomatic truth, but in a tone which quite politely indicated that I might be somewhat heretical on that subject, that there was nothing like hard work. My answer has been what I have often found regarded as a new and startling paradox. Their sons cannot do it because their fathers did it. They have used up in their own persons an exceptional amount of vitality, which has enabled them to struggle successfully against unfavourable and unnatural conditions of life. Surely this explains a fact which has puzzled writers on heredity, viz., that a successful family tends to decay after a generation or two. And it also explains the exception to this rule, viz., the permanence of great qualities in many noble, and notoriously in royal families. It is not the work which kills the vitality, it is that the brain as well as the body is starved for want of the aërated blood supplied by physical labour in pure air.* The outdoor sports which some dyspeptic theorists have decried as "barbarous" have supplied this necessity to the families which have maintained their vigour, and in spite of the strong force of heredity acting the other way, the absence of some form of physical labour has caused what I may call the sedentary families to degenerate. Other causes, such as the coddling and improper feeding of the children of rich townspeople, doubtless co-operate, but the main cause is undoubtedly the one I have stated.

How then is the time to be found for such exercise? Of one thing we may be sure, that if the public becomes imbued with the belief that such labour is above all luxuries, and among the

* It would be hard to find a better illustration of the ignorance prevalent among men of "culture" about the things most necessary to be known, than the following remarks which occur in the *Spectator* for January 19th: —"Sir Charles Dilke presided on Tuesday at the annual dinner of the Tricycle Club, and predicted a great future for cycling, in which he is probably right. But we suspect he was quite wrong in saying that 'physical exertion was probably necessary to fit men for mental work, and to men engaged in such work was an important and necessary relief.' Is that any truer than to say that mental exertion is probably necessary to fit men for physical work, and to men engaged in such work is an important and necessary relief? We believe that the one assertion is quite as true—or quite as false—as the other."

It might as well argue in this way: "Steam is necessary for the engine." Is that any truer than to say "that the engine is necessary for the steam"?

very chief of necessities, the time as well as the place will somehow be found.

But for the present let us go into some details about the path of possible reform. At present for several months of the year almost the entire hours of day-light are spent indoors. I am sorry to hear that during recent years students have had a fresh obstacle put in their way. In my own time at Glasgow our afternoons were always free, and now I hear that there are classes at Edinburgh University which destroy the possibility of afternoon exercise, viz., between three and five. The time bill, I shall be told, cannot be otherwise arranged to suit modern requirements. Then so much the worse for the modern requirements. This piling on of subjects, from other points of view, for both medical and art degrees, stinks in the nostrils of the health reformer, as I shall show later on. But if they clash—health and the extra subjects—which, in the interest of the student, in the interests of his future patients, parishioners, scholars, or family, ought to go overboard—some additional and possibly ornamental knowledge, or the vigour of his brain and body for the work of life? The case of clerks and shopmen is worse. They are, I fear, as a class, a holocaust on the altar of material success. Can nothing be done for them?

Let us begin by putting in the thin end of the wedge. If every indoor worker used dumb-bells or Indian clubs for ten minutes, or took a brisk walk before business hours, the advantage would be great. Let him be thankful if his office is in Leith, and let him vow never to get upon a tram-car. After business hours, it is dark; still I have heard of some ardent spirits getting up in flannels and taking runs on the roads to the wonder of the lieges. They stare. Why do they stare? Let them stare. And if the gymnasia which exist are used, and if rich employers of labour see their duty as they ought to see it, more will spring up. Again, swimming is a glorious exercise. We hear a good deal about its usefulness in saving the lives of others. But few people seem to think that daily access to swimming baths would often keep up the vitality of the swimmers. I hope that the Drumsheugh Baths, in which I hold shares, may soon be run hard by other companies. Oh, if people would only realise the good of such things! One

"statue" would pay for two large public swimming baths. Couldn't we have a Buccleuch Swimming Bath, or a Chambers' Swimming Bath, and a bazaar for it?

Again, is it out of the question for places of business to close much earlier on Saturdays? so that townsfolk may get a good long stretch—let us say over the Pentlands, if no more exciting exercise is available. Some will say, "Oh, in this uncertain climate!" which would prove that they are not in earnest about exercise. It may need a little resolution at first, but seriously I believe the worse the weather the greater the enjoyment—not just at first, but when you are fairly mastering the elements—and certainly the after-glow and the recollection are more delicious. As to cold, provided any one never drives in trains or cab or car when wet or cold, and never sits down in wet things, there is no danger. And to touch for one moment on a delicate subject, the Sabbath was made for man. It was made to supply for each man the rest which he most needs. The strictest puritanical Sunday is indeed better than the Continental Sunday of work, or of what is grimly called gaiety; but to encourage the indoor worker to aërate his blood and refresh his brain by deep draughts of pure air is surely the same in principle as to cause the wearied peasant to rest from the labours of his hands.

Such instalments of progress as these ought to be brought about without much disturbance of existing social arrangements, but they are far from satisfying the demands of hygienic economy. That an immense number of men, especially of young men, and still more of boys, should be engaged in sedentary employments, often in impure air during what are practically the whole hours of daylight for many months in the year, is monstrous. It is a sin against light and knowledge, and will be looked upon by any age which has mastered the principles of physical morality as we look upon the drinking and duelling habits of our forefathers. And it is an instance, not merely of stupidly conservative indifference, but of that more hopeless apathy which goes from bad to worse.

Business hours occupy more daylight than they did some years ago, yielding like everything else to the late hours and morning indolence of so-called society. The courts used to sit at nine, now they sit at ten; offices used to close at three or four, and

open again in the evening for an hour or two. You all know what the hours are now. They are far too late, and, except at some very busy times of the year, unnecessarily long. Will any business man tell me that if there is a will in this matter there is no way; that half-a-dozen men, commissioned by the general assent of the community, could not so rearrange matters by beginning earlier, by shortening some cumbrous conventional forms, and by other arrangements for preventing waste of time, and if necessary, by opening again at night for the winter months, that one of the first necessities of health should be secured to all who will make use of it, though until the truths of physical morality are made an integral part of education, only a minority may make use of it? But suppose this is impossible, suppose the hours to remain as they are, is no alleviation possible? I asked a friend once if fives courts could not be built for the clerks on spare pieces of ground behind offices. Of course I heard that this would be too eccentric, scarcely respectable, &c. He was quite right, I suppose; but surely, ladies and gentlemen, this shows a very wrong state of feeling. Either the accepted doctrine of the aëration of the blood by physical labour is wrong, or the state of feeling is wrong, one or the other.

I am satisfied, if leading lawyers and merchants and bankers felt the truth, as well as knew the truth, that a crop of gymnasia, fives courts, and lawn-tennis courts would spring up, and that many dreary hours in which clerks and even principals are gossiping or reading novels, would be spent in gaining benefits which are as demonstrable as the truths of Euclid.

Of course I know that all this is unpractical at present. Why then have I taken up your time in sketching such a Quixotic scheme? Why, because the more unpractical it is the more it proves my contention: that health reform is obstructed by indifference, and will be so till education and life are saturated with its teachings.

But what of my next subject—food? Does this indifference extend to it? or is there not rather a tendency to a morbid fanciful particularity about what we eat and drink? And are not violations of health laws in this respect due rather to individual self-indulgence than general apathy?

This is increasingly true, with many qualifications, of the private life of a large part of the wealthier and middle classes; but sins of indifference are neither few nor small. It is surely not necessary to dilate on the importance of an abundant milk supply. Milk is the only food which contains all the necessary elements of diet, and healthy children cannot be reared without plenty of it.

Now, not only in towns, but in many country districts the children of the poorer classes are being starved and stunted from want of milk. You can't grow men without growing children, and you can't grow healthy children without plenty of milk. I wonder if this truth was mentioned in the free trade debates of 1846. I have read most of these debates and don't remember that it was. It would have constituted the only sound argument of the Protectionists against free trade in cattle, but political economy was then in full swing, and I doubt if hygienic economy could have got a hearing. For the latter insists on there being cows enough in the country to supply abundant milk for every individual in it. I have not known where to look for statistics, but I fancy that the milch cows in the country have *not* increased in proportion to the population, or even absolutely within the last thirty years.

And then the nation became victimised by a craze, ruinous from many points of view, for the enclosure of commons. Fortunately, that is now seen to be sheer madness, and the successful fight for the preservation of Epping Forest is a sign of a more wholesome state of feeling.

But not only in very many instances have the healthy sports of villagers been put an end to, but the villagers have lost the feeding ground for their cows, and now in many parts of the country the poor people can scarcely get milk at all. The farmer finds it pays better to send it to London and other big towns. Now it is very well to sneer at grandmotherly legislation, but there will be more grandmothers than grandchildren unless there is milk to be had. If giving the labourers votes will enable each of them, I scarcely care by what means, to have a cow's grass secured to him by law—well, I hope they will get the votes, though for sentimental political reforms I don't care a jot. We can't afford to lose any of the affluents of the Volga, which keeps up our national Caspian.

Now we have been growing bigger and stronger men in Scotland than in England. I'm not bragging, for I'm an Englishman. And I can't stop to give you proofs, but I will just say in passing that the way in which the little country holds her own with the big one in Rugby, and still more so in Association football, is a fact which strongly illustrates my assertion. And the bigger men have been throughout the world the most successful men, out of all proportion to numbers, and the bigger men, other things being about equal, are the product of the better food, oatmeal and milk.

There may be other causes, but depend upon it this is the chief cause. Now is it true, that partly from a shorter supply of milk in proportion to population, partly from ignorance about food, and also, I fear, a certain snobbishness about food, that tea and white bread, *i.e.*, bread robbed of some of its best qualities and made to look as if it were more robbed than it is, have been largely taking the place of oatmeal and milk? I don't say that this is the case among grown-up people of the richer classes, and with them it matters less, because the ingredients of perfect diet are for them supplied in other ways. But it does matter greatly for the poorer classes, and it is a question of strength or of feebleness for the children of all classes. I have often been perfectly aghast on finding that people who could afford good milk have been trying to bring children up on white bread and tea and slops. And then if the poor things are delicate, they think that the cure is warm rooms, frequent feeding on dainties, confinement to the house when wet or cold, plenty of wraps and slow motion out of doors on fine days!

If the principles of diet and life were taught in some of the schools for both sexes, instead of the mountains of South America, or the lives of the poets, or that painful exercise called paraphrasing, there would no longer be the excuse of ignorance for such disastrous blunders as these and many others of a similar nature.

I mentioned football players. Let us say a word to them. I can't be accused of want of sympathy for games. There isn't time to mince words, and I hope they will excuse plain ones. The game attracts spectators. Spectators pay gate-money. Gate-money pays for football tours. Good and well; and it pays for something which is not good and well, expensive football dinners.

Now I know that a good many football players don't like this, and they haven't the pluck to decline to go. They are more afraid of giving offence, than of doing a thing bad for themselves, worse as an example. They know that these dinners put men out of training. They make a farce of the final matches of the tour, if played by the same men. I saw an instance of this mentioned in an English paper the other day. But they do something worse than spoil football. After severe exercise, permanent injury is more easily done to the digestive powers than at any other time. In all athletics, going out of training has done far more harm than overtraining. And these football dinners will do far more damage than all the football accidents about which all the old women scream, and damage of a more lasting kind too. Now, be deaf, if you are wise, to the kind invitation of the outsiders who promote these entertainments. Tell them that you will be very glad to see them in your scrimmages, but you won't go to their dinners. Never mind if some of the papers abuse you, as the London press once abused the Oxford crew for refusing to go to that dreadful feast after the boat-race. If you can't stand a bit of abuse, you will never do any good. And then, silly abuse for doing what is right is so infinitely amusing that it lightens the real difficulties of health-reformers.

A good deal has happened since I wrote my remarks on this subject. We have had a visit from the Vice-President of the Committee of the Education Council. And I think that, however much we may all differ on other matters, we must all agree that Mr Mundella has displayed great qualities, and deservedly won golden opinions on all sides. He has not degraded education by making it a stalking horse of any political or ecclesiastical sect, and he has displayed an industry, a mastery of detail, an open-mindedness, and an enthusiasm which are the very antipodes of the red tape officialism which we have often had occasion to deplore. It is one of the great defects of our present system of party government that any change of Ministry might possibly instal a successor in the Education Department who had the very rudiments of his subject to learn.

That he views education more on the purely intellectual than on the physiological side, is the necessary result of that tone of public opinion, which it is the object of these lectures to combat

It must indeed have gladdened the heart of every health-reformer to read his remarks on the over-work of pupil teachers to which I referred in my last lecture, and his criticism on the manner in which the present working of payment by results puts a premium upon over-pressure.

But there is one remark of his which I wish to quote, as I think it is the source of a common and dangerous fallacy. He says, "Now I don't mind the boys working a bit. I have been a lad myself and worked very hard, and a little hard work does not harm a boy." Quite true, it not only does not harm a boy, but it does him a great deal of good. Nothing great or good is done without hard work. What harms a boy is the presence of hard mental work coupled with the absence of hard physical work. Without some form of physical labour, as I tried to show in my last lecture, it is impossible for an individual to be thoroughly robust, and it is certain that a people will degenerate.

What I complain of is, that our town schools in general do not supply this physical work, and that people's eyes (even Mr Mundella's eyes) do not seem to be open on this subject. Do not think that by physical work I mean merely games; though games in their place are right and necessary. But every town school ought also to have a gymnasium. Gymnastics should be a compulsory school class, and every boy ought to learn, if not a manual trade, at least how to use carpenters' tools; and if he also learns to use a pickaxe and a spade so much the better. Such learning would not only save many a colonist from ruin or starvation, but it would keep up the health and vigour of many brain workers, as the use of the axe has kept up Mr Gladstone's.

I fear that in our zeal for intellectual education we have been losing sight of a great truth, eloquently expressed by Archdeacon Farrar: "Physical work is a pure and noble thing, it is the salt of life, it is the girdle of manliness, it saves the body from effeminate languor and the soul from polluting thoughts. And therefore Christ laboured, working with his own hands, and fashioned ploughs and yokes for those who needed them."

I know how hard it is to manage this matter of physical labour, natural or artificial, in towns. It can indeed be managed by schools for the wealthier classes, more easily than by grammar

and board schools. But nothing can show more clearly the extent to which this momentous matter is ignored, than the schemes which are afloat for connecting primary and secondary education. An influential speaker mentioned last Wednesday with approbation, the remark of a friend about a clever boy at a country school, "What a pity it is that that boy cannot get a bursary, and go away to some town." Now, great ability will force its way anywhere; but depend upon it, if you bring a number of country boys of moderately good ability into towns, if you give them hard mental work and little if any physical work, you will simply succeed in turning a number of feeble youths, without capital, and rendered incapable of earning a living by manual labour, into the already over-crowded occupations open to men of education; and one chief result of this wrongly-directed zeal will be a number of consumptive copying clerks.

But why should not our vast educational endowments be partly used in erecting great and cheap schools in the country, like the Devon county and many others in England, where an all-round healthy education could be given, and not one in book-knowledge alone? And other schools again, on a somewhat similar plan to Cirencester and Dowton Agricultural Colleges, where a technical education should be superadded to the intellectual, and some of these clever boys turned into what is so much wanted in our colonies, robust emigrants with scientific knowledge, and yet with a mental training which shall prevent them from sinking into boors?

But it must be evident to all who have read the accounts of recent meetings, that the hygienic aspects of education are being ignored by our leading men; and if they continue to be so ignored the proposed developments of our educational system will do a great deal more harm than they will do good.

The truth is, that the public have been looking at education too exclusively from one point of view. They have not studied Dr Clouston's subject for next Saturday—"The child, body and brain." I hope you will all come and hear what he has then to say, for he knows more about the subject than you or I do, or than any of the statesmen and notabilities do who have lately been making educational speeches.

I will not trespass much upon the ground which I think he

will take; but there is one important feature in the present education of the child in Scotland which I have tried to realise, in imagination, as applicable to myself.

Suppose a large portion of my income depended on pupils passing certain examinations at particular ages, and suppose I said to my colleagues, "Now, gentlemen, as my income depends, so yours must, on the number of boys you pass." Would I not be putting a premium on their regarding their boys as simply machines for getting passes? Is human nature so universally disinterested that I could expect them all to study their charges from the health point of view, to recommend that one should not work by gas-light because his eyes were weak (the German experience on this point is worth studying), or that another should not be pressed because he was growing more than the normal rate, and that the calls on vitality in other directions demanded that for a time no serious call should be made by the brain? And this danger seems to me intensified in case of the Board schoolmaster. A leading man in the profession writes to me: "These Boards value their teachers by their percentage of passes, and this forms another stimulus to the teachers, and leads to inconsiderate teachers keeping children in past the hours in their time-table, even though they be weak both physically and mentally." Now, if *I* were to regard boys simply as representing so many passes or marks, they have parents who are more keenly alive to signs of danger than the parents of very poor children are. And if the poorer parents do see that their children are stunted, or suffering in eyesight, or from headache, or listless from too rapid growth, or if they agree with an eminent physiologist, quoted by Mr Herbert Spencer, that many children should learn no lessons till they are eight years old; why, the officer delivers them to the school board, the school board to the sheriff, and they are cast into prison.

I know well enough the evils of leaving such discretion in parents' hands, but why, I ask, is there not a physical inspection of schools? to test the ventilation, to take registers of growth, chest girth, and lung capacity, to prescribe which children should be full and which half timers (on which subject—referred to, I am glad to say, by Mr Mundella—*vide* Mr Edwin Chadwick's too much neglected blue-book), and which should be relieved for a

time from brain work altogether. Then ought there not to be daily drill for all, if possible in the open air, and ought not inspectors to award grants, not only by the regular school work, but by proficiency in such drill, by the discipline and cheerfulness of the children, and by those numerous indefinable signs of health and well-being which cannot be mistaken by a practised observer?

N.B.—On this whole subject I wish to refer to an extract from the *Medical Times*, printed in the appendix to this lecture.

I cannot give you a better proof of the indifference prevalent about such matters than the words of an eminent living statesman. I don't name him, because I don't want to drag in political associations. "Everything that can be said on the subject of education has been said hundreds of times over." So it has, if you regard education as the battlefield of political and ecclesiastical sects. So it has, if you look upon the immature brain as a sort of disembodied and infinitely elastic wind-bag, which is the point of view taken in weary piles of blue books, in precise, cold-blooded codes, or in the polished platitudes of numerous honourable, right honourable, and noble amateur educationists, most of whom know as much about the body and brain of a child as I know about the working of the Home Office or the India House. But so it has *not*, if you regard education as the scientific and harmonious development of the entire nature. Even from a purely intellectual point, if we look upon the brain as an organ and not as a wind-bag, if we consider that the main object of intellectual education is not so much to inform (except on one or two subjects, the most important of which, as I shall show you, is almost utterly neglected) as to train, that its success is to be measured, not by the knowledge which it temporarily imports, as by the powers of acquiring and using knowledge, which it permanently strengthens, we are in the midst of an educational chaos. This is fortunately not my subject. I have not to discuss here the conflicting and still unsettled claims of what I may briefly denominate the old and the new learning. What I have to do with is the indifference which has been shown concerning the health, both of mind and body, of the victims of this conflict.

I need scarcely say that though under any circumstances the addition of new subjects without the suppression of old ones

would have required careful watching from the health point of view, yet the dangers in this direction appear most strongly in connection with the examination system, which now dominates education, and which has attained its present portentous dimensions within the last thirty years. Some method of testing merit was certainly rendered necessary by the abuses of patronage, but that health considerations have been ignored by the framers and promoters of the examination system is, I think, undeniable, and the outcome of the system as actually worked is admitted by every true schoolmaster whose opinion I know to be fraught with much evil. But I am aware that the opinion of schoolmasters is not worth having—on educational matters. Education commissions do not include a single expert, though I would like to see the flutter there would be in the assemblies and the Parliament house, or among medical men, if other professions were ignored in this way. As to the way in which the Board schoolmasters have been ignored, I had written something else very strong and very true. But something has happened since I wrote. Mr Mundella's noble speech at Glasgow is the first instance I have met with of a sympathetic recognition being accorded to them by any English official.

So I will give you first, the opinion of the greatest living philosopher, Mr Herbert Spencer. In his Essays on Education, which are less known than they should be, and which contain more valuable matter than could be distilled from all the speeches on the subject which I have seen in newspapers, he says, "And if, as all who investigate the matter must admit, physical degeneracy is a consequence of this excessive study, how grave is the condemnation to be passed on this cramming system above exemplified. It is a terrible mistake from whatever point of view regarded. It is a mistake in so far as the mere acquirement of knowledge is concerned.

"For the mind, like the body, cannot assimilate beyond a certain rate; and if you ply it with facts faster than it can assimilate them, they are soon rejected again; instead of being built into the intellectual fabric, they fall out of recollection after the passing of the examination for which they were got up. It is a mistake, too, because it tends to make study distasteful. Either through the painful associations produced by ceaseless mental

toil, or through the abnormal state of brain it leaves behind, it often generates an aversion to books; and instead of that subsequent self-culture induced by rational education, there comes continued retrogression. It is a mistake, also, inasmuch as it assumes that the acquisition of knowledge is everything; and forgets that a much more important thing is the organization of knowledge, for which time and spontaneous thinking are requisite. As Humboldt remarks, respecting the progress of intelligence in general, that 'the interpretation of nature is obscured when the description languishes under too great an accumulation of insulated facts.' So it may be remarked respecting the progress of individual intelligence, that the mind is overburdened and hampered by an excess of ill-digested information. It is not the knowledge stored up of intellectual fat which is of value, but that which is turned into intellectual muscle. The mistake goes still deeper, however. Even were the system good as producing intellectual efficiency, which it is not, it would still be bad, because, as we have shown, it is fatal to that vigour of physique needful to make intellectual training available in the struggle of life. Those who, in eagerness to cultivate their pupils' minds, are reckless of their bodies, do not remember that success in the world depends more on energy than on information; and that a policy which in cramming with information undermines energy is self-defeating. The strong will and untiring activity due to abundant animal vigour go far to compensate even great defects of education; and when joined with that quite adequate education which may be obtained without sacrificing health, they ensure an easy victory over competitors enfeebled by excessive study; prodigies of learning though they may be. A comparatively small and ill-made engine, worked at high pressure, will do more than a large and well-finished one worked at low pressure. What folly is it, then, while finishing the engine, so to damage the boiler that it will not generate steam! Once more, the system is a mistake, as involving a false estimate of welfare in life. Even supposing it were a means to worldly success, instead of a means to a worldly failure, yet in the entailed ill-health it would inflict a more than the equivalent curse. What boots it to have attained wealth, if the wealth is accompanied by ceaseless ailments? What is the worth of distinction, if it has brought

hypochrondria with it? Surely no one needs telling that a good digestion, a bounding pulse, and high spirits are elements of happiness which no external advantages can outbalance. Chronic disorder casts a gloom over the brightest prospects, while the vivacity of strong health gilds even misfortune. We contend, then, that this over-education is vicious in every way—vicious as giving knowledge that will soon be forgotten; vicious, as producing a disgust for knowledge; vicious, as neglecting the organization of knowledge, which is more important than its acquisition; vicious, as weakening or destroying that energy, without which a trained intellect is useless; vicious, as entailing that ill-health for which even success would not compensate, and which makes failure doubly bitter."

Next I will give you the opinion of an educator who was allowed a hearing, and was honoured, I think, by a leader in the *Times*, chiefly, I fancy, because he was for a short time in Parliament, and thereby became a member of that circle of peers, M.P.'s, and celebrities whose opinions on all subjects are worth recording. The writer is Mr Wren, the prince of so-called "crammers." Some people are scarcely fair to crammers. Their business is to get boys through certain examinations. Where "cramming" is unluckily necessary, they cram; but they also *teach*, at one particular stage, better than most schoolmasters do, because this stage is their speciality. That boys have to be sent to London to be so taught, with scarcely an element of healthy life open to them, is the fault of the system, not of the crammers. The purport of the letter (the whole of which will be found in an appendix) is a protest against competition at the growing age. It concludes—"You cannot make babies do boys' work; and you cannot make boys with immature brains do young men's work without injuring these brains; and mark, the brains always give way before the physical health suffers. If you put too many irons into the fire of a boy's mind, and keep on blowing at that fire to see whether you can keep all these irons hot, you will very soon burn that fire right away to dust and ashes."

I have not space to go into details, or I would tell you how the public school scholarships can now scarcely be obtained by any boy who has not had an arduous and expensive training, and how, consequently, the gifts of past ages to the poor have been

perverted into an unhealthy stimulus for the rich,—how for college scholarships, similarly perverted, and for Indian and Woolwich appointments, the age of competition has been reduced to 18 (or rather, under 19), thereby throwing the greatest strain on the age least able to bear it, when the growth is most rapid, when the seeds of life-long infirmity are most easily sown.

Some one may say, are not physical competitions equally bad? Yes, I answer; they would be so if you were to give enormous money prizes for mile races open to boys under 14, and for three mile races open under 19. As it is, the longest race I know of open to boys under 14 is 300 yards, and to older boys it is one mile. And no boy should run mile or perhaps quarter mile races without medical leave, or if growing very quickly. But no such precautions are taken about our intellectual races. The prizes are not only big, but the competitors feel that their success in life depends on gaining them. They enter the contest not only with brain prematurely forced, but with blood insufficiently aërated by exercise, with cheeks unduly paled and chest unduly narrowed by sedentary work, often for ten or more hours daily, and with nerves unduly stimulated by the unnatural strain.

One effort was made to alleviate the evils of this system, and it was baulked.

Some years ago a Royal Commission reported in favour of giving marks for physical accomplishments, such as rowing, gymnastics, leaping, and running, in the case of candidates for army appointments. The standard for full marks in any case was not high. The total marks attainable were only equal to what might be gained by judicious cram about English literature. No premium would have been put upon excessive athletics, but candidates would have had some inducement to keep in a healthy condition by moderate exercise, and their life as well as their knowledge would have become the care of their tutors.

But the scheme was rejected by the supreme officials. Once or twice Lord Bury and others have raised a languid debate in Parliament, but unfortunately subjects affecting the healthy life, and not merely the healthy surroundings, of any class of the people do not as yet interest that assembly, and will not do so until they interest the nation.

The system of competitive examination has had free swing in

China for centuries. It has given her the mandarin. The selection of warriors by paper work, tempered by a previous London life partly sedentary and partly loose, is a climax which has been reserved for our riper civilisation.*

Time forbids my showing in detail how the tendency towards examinations and multiplicity of subjects has caused the health point of view to be put out of sight in other departments of education. But let me ask, with some diffidence, whether an unnecessary strain is not put upon medical students? Is all the technical knowledge which is exacted from them in chemistry, botany, and natural history, knowledge of a kind which they must or can always keep at their finger's end? or is there not much of it as to which the most skilled practitioners never trust their memories, but invariably use books of reference? And with respect to the Arts curriculum, was it necessary to add to it the formal study of English? I think that a great deal of nonsense has been talked upon this subject. The chief object of studying English is to learn to speak and write English, and this object was previously attained by translation from other languages, and by writing answers and essays in the philosophy classes, and all the great English speakers and writers have been trained without such formal study. We cannot live without water, but if we have plenty of milk and succulent diet, we don't require to drink water by itself. But if English must be a subject explicitly and not implicitly examined on for a degree in arts, surely, from the health point of view, it would be better to make it an alternative subject with Greek or Logic, than having it from 4 to 5 P.M., to make games or country rambles an impossibility for the students.

The same tendency to teach all subjects separately, and the same mistaken notion that all the information which we may have to use in life, ought to be stored away in the mind, at school or college, are the sources of inordinately long school hours throughout the country, and of many muddled brains. Just to illustrate what I mean. If any of you wished to be sure of the position of some cape in Africa, would you trust to school recollection, or would you look at a map? But it is surely better that children should leave school less well-informed, than that they should have

* And *vide* extract in Appendix on physical qualifications of civil servants.

an enfeebled body and brain. I have in my possession the time-table of a large and expensive English school for boys from 7 to 14, in which the hours of work for three days weekly, besides two compulsory chapels, amount to eight hours and fifty-five minutes. And I am assured, that at several of the great schools, owing to pressure of subjects, for three days in the week boys get no exercise worth the name.

Well, I fear that, acting on the shoemaker's principle, that there's nothing like leather, I have troubled you at inordinate length on the subject of education.

I have so far been attacking the mountain of indifference with a pickaxe, and I shall not occupy much time in the still more futile task of battering the shifting sand hills of fashion with the artillery of reason.

Ladies and Gentlemen, you need not be afraid, especially the ladies. I am not going to bring a skeleton out of a cupboard, or a torso from a museum, and compare nature and art with the help of a dressmaker's model hired for the occasion. Nor shall I prove the case against the fashionable boot, male or female, or the less guilty plebeian boot, for it has been proved a hundred times over by demonstration as rigorous as that of Euclid, how high heels disturb the balance of the figure, how narrow heels increase the chance of sprains, how cramming the toes together produces minor ailments, and how, above all, causing the joints of the great toe to work round a corner, instead of in a straight line, affects the whole mechanism of the foot and leg, and if it does no appreciable damage in youth, injures the power of locomotion in later life.

But let me tell you of what has been done at Lexington in America. It is a school of 300 girls, of the average age of seventeen, largely from wealthy families, deformed and made delicate by a fashionable life more unwholesome than our own. The constant dress at Lexington is short and loose, leaving the girls as much liberty as boys have, in what I think the best of all school dresses, the cricket dress. The gymnastic work is hard, the games and dancing vigorous, and the intellectual results, without over-pressure, are extraordinary. "What a slave I was," exclaims a pupil, "I have now just begun to live."

You may find a full account in *Health*, for June 15, 1883, and in the *Journal of Education* for, I think, the same month.

Some will say—But surely fashion is progressive. I fear not. The instinct of self-inflicted deformity and self-torture is found in all barbarous tribes; it is closely allied with moral evil, and it is one of the most serious difficulties of the Darwinian theory that not a trace of it is to be found in the lower animals. It would, in fact, handicap the self-injuring animal in the struggle for existence. Hence even if a bad fashion has been got rid of for a time, there is a tendency to periodical reversion "to type" not of the brute but of the self-injuring human ancestor. Let me give you an illustration.

At the beginning of this century the necks of men were enveloped in numerous folds of neckloth, and consequently the old gentlemen of that period died in large numbers of throat complaints. Things got better. The tie was worn only twice round, then once. But still walls of starched linen encumbered the free movement of the throat. Men of my age will remember the year of emancipation, about 1855. And I may surely assume that reason is all on the side of the throat being free.

The great preacher Mr Spurgeon says in his lecture to students: "Take care of your throat by never wrapping it up tightly. If any of you possess delightfully warm woollen comforters, with which may be associated the most tender remembrances of mother or sister, treasure them in the bottom of your trunk, but do not expose them to any vulgar use by wrapping them round your necks. If any brother wants to die of influenza, let him wear a warm scarf round his neck, and then one of these nights he will forget it and catch such a cold as will last him the rest of his natural life. You seldom see a sailor wrap his neck up. No; he always keeps it bare and exposed, and has a turn-down collar; and if he has a tie at all it is but a small one loosely tied, so that the wind can blow all round his neck. In this philosophy I am a firm believer, having never deviated from it for these fourteen years, and having before that time been frequently troubled with colds, but very seldom since. If you feel that you want something else, why, then, grow your beards! a habit most natural, scriptural, manly, and beneficial."

Now you all know what has happened within the last year or two. Phenomena like those of which the "masher" is the extreme development are interesting to the naturalist. They show reversion to an ancestral type, but not to that of any animal. Animals are not such fools. What elephant ever stuck pins into its trunk? What "beast that wants discourse of reason" ever tried to look as if it was throttling itself?

But you may say, If people oppose fashion are they not eccentric? Well, there are two kinds of eccentricity—the eccentricity of affectation, and the eccentricity of purpose. It is of the latter kind that John Stuart Mill says, "Eccentricity has always abounded when and where strength of character has abounded." Old Jonas Hanway, the first man who dared, in spite of the jeers of street boys, to carry an umbrella in London, was a much wiser man than the fools who laughed at him. He was the originator of many sanitary reforms.

If we can conceive a rational age looking back upon the present, what will it say to the mass of woollen clothing with which men encumber themselves in hot climates. There is a well-known picture in missionary journals of a man in solemn black addressing a group of natives in cool white garments. The sanitary missionary should be represented in a single ply of loose white flannel preaching to a group of Europeans in costumes which would pass muster at a Government House. Settlers dress sensibly. True; but when ladies come, men are supposed to be bound to pay them the doubtful compliment of incurring serious discomfort, and increasing the risk of fever by wearing more plies of clothing than they require, though English women are not in this respect as sensitive as the Russian ladies who pulled down their blinds because some Englishmen took off their coats to play lawn-tennis.

The *Lancet*, during a rarely hot summer, once said that the physicians of London would do more good by setting the example of dressing in loose flannel raiment than they could do in any other way. It was a courageous opinion. The physician of the future city will not tell us that clothing should be absolutely loose, of open texture, washable, and frequently washed—even in the clean city of the future—and of light colour, and in respect of

thickness and number of plies adapted entirely to the heat economy of the body, and at the same time dress himself in all climates in well-fitting dark garments of close texture. But I fear that though a few streaks of dawn may be visible, more perhaps in America than in this country, the day is not near at hand. We may indeed be cleansed from the leprosy of conventional opinion, but we must all of us yet awhile worship in the house of the Rimmom of custom, much as some of us might like to dash its graven images to the ground. But what of the claims of grace and beauty? I think that the ingenuity of the future may possibly invent something which shall satisfy the demands of truth and reason, and yet not fall far short in beauty of colour and of form of modern male costume.

There is, however, one matter of pressing, yes, even of pecuniary importance. The modern soldier is an expensive article. Do we wish to save money as well as life? What says science? The dress should be so free as to permit the unconstrained movement of every limb, loose and porous in texture. Such a dress also, especially for persons who have sometimes to undergo great changes in temperature without a change of clothes, is demonstrably the best for the heat economy of the body.

The head dress should be as light as what is called the deer-stalker, and in hot climates, a pith hat. The feet, I need hardly say, should be scientifically clad. An army so attired, if also provided with play-fields as well as gymnasia at all military stations, would pay for the cost of play-fields by decreased sickness and mortality, and would march round any army in Europe.

Now what says military custom?

In our last great war, the Crimean, the sea-sick troops, in narrow transports, had first to excoriate their chins in depriving themselves of the natural protectors of their throats. They were landed without tents and without waterproofs, exposed all night to torrents of rain, in tight clothes of that close texture which strikes a deadly chill when soaked, and dries most slowly, and then on the hot march which followed, men fell out, literally throttled by tight black stocks, worse than any masher's collar, while cholera all the time, aided by military stupidity, grimly revelled in her dance of death. And Dr Cathcart told you last

year, how this matter of clothing was put to a practical test in the Egyptian war. Two bodies, nearly equal in number, one of sailors, another of soldiers, accomplished the same march under a blazing sun. Of the soldiers, more than 100 fell out; of the loosely clad sailors, not a single man.

And have any of you ever seen, as I have, a squadron of recruits drilling, and swinging their arms in extension movements, in their close-fitting tunics? What drill instructor would ever suffer such a thing in a school? though I did hear of a school in England the other day, where, in spite of drill instructor, the master compelled the boys to do gymnastics in collars and waistcoats, lest they should catch cold.

I mentioned in my first lecture the excessive mortality from consumption among the Guards. It was largely due to bad ventilation. This was partially set right. But a large residuum remains, and it cannot be doubted that it is mainly due to the free movement of the mens' ribs and chests being obstructed by belts and close-fitting tunics. That free dressing increases the chest girth, and therefore the lung capacity, is, to my own mind, amply established by registers which I have carefully kept and averaged for more than nine years. But there is no time to enter upon this subject.

The evil influence of fashion is, I fear, not confined to dress. It affects the whole of life: the drinking customs of men of the lower, and, till lately, of the higher orders; the feeding customs by which people injure the digestion for life of their own, and, if they get the chance, of other people's children, and which, I fear, often tempt children of larger growth to waste what they have, and sometimes to spend what they have not in the absurd dinners and other feasts of a society which is rivalling many of the worst features of the Roman Empire; the funeral customs, which foster disease by artificially fostering depression, when the vital energies are already lowered by grief, which often take the bread out of the widow's and children's mouths to pay for crape and other black habiliments of woe, which prescribe inaction when air and exercise and employment are most necessary, which even shut out the light of heaven further to blanch the mourner's cheek, and to deepen the mourner's gloom. It affects not only

these, but in every circumstance of life this heartless and unreasoning tyrant still holds civilized man in slavery, and more even than indifference, clogs the advancing wheels of Health Reform.

What, then, is the remedy for these things?

What is the remedy for all evil?

Reverent obedience to the will and laws of God.

Such reverence and such obedience should be made part of a child's habits and nature from the first dawn of intelligence; they should be an essential part of the training of school; they should be constantly instilled from every pulpit. We should teach them, as the Jews of old were told to teach what was then known of God's laws, "diligently to thy children, when thou sittest in thy house, when thou walkest by the way, when thou liest down, and when thou risest up."

But what of our schools?

Miss Phœbe Blyth said lately at Galashiels, that the "Instruction" Act should be called the "Information" Act. I have a further count against it. The teaching which it prescribes informs where it should educate, but it does not inform where it should. The knowledge of how to live our lives is conspicuous by its absence from education. The child leaves Board schools, and many other schools, with scarcely a scrap of that information which should be so early and deeply engrained as to become an integral part of its mental habits and constitution. A child usually learns nothing at school about the air it breathes, nothing of the principles of ventilation, which indeed are grossly violated in a vast majority of sleeping rooms and school-rooms in which children live, or of the cleansing away of impurity and infection by the best of all disinfectants—fresh air: it learns nothing about food, not even the practical lesson (suggested by the *Spectator*)—and surely this would be a better use of part of our vast educational endowments than the institution of baby scholarships—of a daily meal of porridge and milk for ill-fed children: it learns no reason why it should not eat trash, or eat fast, or eat between meals, if well fed at meals; no reason why tea and white bread will not nourish it as well as the diet on which its forefathers throve; nothing about the preparation of food, an early neglect which causes almost as much good nourishment to

be wasted as is used throughout the country; nothing about the functions and necessity of exercise, which is treated mainly as an amusement, and which, owing to a sentimental clamour against the rod, is too often forfeited as a punishment; nothing about clothing, why it is better to sit in bare feet than in wet boots, why muffling the throat, as is now being done, without remonstrance from their teachers, by the poorer class of boys throughout Scotland, weakens the throat, and why the compression or distortion of any part of the person is not only an implied blasphemy against our Maker, but an injury to ourselves. It may learn science, but it is the rote and unpractised science of the text books; it may learn names of places which leave no useful or permanent impression on the mind; details and pat criticisms about authors, whose works it has never read; the bare outline and possibly the romance of past history, but nothing of the true work or the urgent needs of the present age. It may have offered to it possibly the dry bones of religion, unbreathed upon by that spirit which alone can make these dry bones live, without any reference to the laws which our Creator has ordained to govern the life, and minister to the happiness of His noblest handiwork.

Some of you must know the great inspiring words of the author of "Ecce Homo." They seem to me to embody an essential corollary of Christianity, and to be fraught with a truth and a power equal to that of any words ever penned by man: "Christ commanded his first followers to heal the sick and give alms, but he commands the Christians of this age, if we may use the expression, to investigate the causes of all physical evil, to master the science of health, to consider the question of education with a view to health, the question of labour with a view to health, the question of trade with a view to health; and while all these investigations are made with free expense of energy and time and means, to work out the rearrangement of human life in accordance with the results they give."

There is now no longer the excuse of ignorance. Surely to all of us, as once to the idol-worshipping, but no longer idol-reverencing Athenians, the voice sounds loudly:

"The times of this ignorance God winked at, but now commandeth he all men everywhere to repent."

APPENDIX.

HEALTH AND COMPETITIVE EXAMINATIONS.

(*To the Editor of the "Times."*)

Sir,—I read on page seven of your issue of to-day an elaborate paper read at the Social Science Congress by the President of the Health Department. Your correspondent says the President "availed himself of the opportunity of giving utterance to thoughts which had forced themselves upon him as a medical man, as a professional teacher, as a university examiner," in reference to the tendency of modern education to influence health and physical growth and development. The President said, "Competition had become a plague spot." He pointed out that there is competition for the services, for college scholarships, for public school scholarships, and that in the last there is "severe competition among boys little above childhood." He said, "The successful boy must bear the strain till he breaks down, or till he began the work of life an exhausted man;" that "a warning note had come from India on premature failure of health, exhausted faculties, and shattered nervous systems;" that Sir A. Clark asserts that "of the young men who win appointments in India more than one-tenth become albuminuric;" that Dr Browne says, "The future of the race constrains all medical men to preach the wisdom of caution, and the danger of brain-forcing, and to impress on parents and teachers that to overwork the miniature brain is to enfeeble it." His conclusion was that he "saw injury to health, degradation of intellect, and a departure from a true ideal of education, because we are importing (he might have said "have imported") into modern education hurry, worry, anxiety, selfishness, competition, and feverish desire for success, prize-winning, place-winning, and mark-winning, all tending year by year to grow in intensity and to become more powerful agents."

This is all right enough, and might have been made much stronger. There seems to me a little confusion of thought, because a desire for success is not a crime, or, indeed, anything but a good thing. Prize-winning, too, is not a bad thing in itself, and not necessarily the same thing as "brain-forcing." Sir A. Clark has won the prizes of his profession. Competition and place-winning are always going on among the leaders of men in all lines of life, and there are rivals for the "place" of Prime Minister and Lord Chancellor, as well as for appointments in Her Majesty's Civil and Military services, for school and university and college scholarships, and for "a first" in the University Class-lists. Where there is competition and rivalry, there must be some selfishness

and some anxiety, however little. It is the "hurry" and the "worry" which does the mischief. One of my earliest recollections is how Kirke White virtually killed himself by overwork and anxiety in competing for the blue ribbon of the year at Cambridge—to be Senior Wrangler. There is a well-known case at Cambridge of a man who read twelve hours a day for three and a half years to get "a double first"—got it, never recovered from the strain, and ultimately committed suicide. There are doubtless many other cases, both at Oxford and Cambridge, which could be quoted; but I never heard that anyone wanted to abolish the Classical and Mathematical Triposes at either Oxford or Cambridge because of them. And why? Because the cases are so few. Similarly, we never hear any of those sad stories about young men who have won appointments in the Home Civil Service. The reason is plain. Most young men did not injure themselves reading for university honours, because they did not compete till, say, twenty-three years of age. Similarly, candidates for the home Civil Service can compete up to twenty-four. The President of the Health section made a point when he drew attention to the fact that "the marvellous opening out of the field of natural science compelled the universities to widen their borders and give the younger science a place beside the elder sisters." He might have added that whereas, not so very many years ago, there were only classical and mathematical class lists at Oxford and Cambridge (the Classical and Mathematical Triposes), there are now law, history, moral science triposes, as well as for "natural science." As there is more to do for an earnest student, you might have expected that a little more time would be allowed. In bygone days men went up to Cambridge occasionally at twenty-four and twenty-five, and sometimes even older. The best instance I remember is Mr Todhunter. He, not choosing to be hurried, did not go up until older than most men when they take their degrees. Then the theory was started that such cases defrauded really cleverer though younger competitors, and a rule was made in some colleges that candidates for College Scholarships must be "under twenty years of age." And quite lately the age has been cut down to nineteen. The best men, therefore, must either go without scholarship (which very few like to do, or will afford to do if they can help it), or take their degrees at latest when they are twenty-three. Hence it appears that the cleverest and sharpest and most promising little boys are carefully coached for Public School Foundation Scholarships, for which they must be "under fourteen,"—are then carefully coached for College Scholarships, for which they must be "under nineteen,"—and are then carefully coached for their degrees in honours, which they take (or miss) when "under twenty-three." The worst of this is that you risk

ruining the best intellect. It has always been known that the reputation of Eton has been kept up for years by the Foundation Scholars, who were carefully coached and looked after, sixty or seventy in number. The other 600 or 700 picked up what they could. Hence some of those who were luckily for them ignored have come out the best. I have known more than one case of brain failure during the last quarter of a century among the Fellows of King's. I have heard of no cases among the successful competitors for the Home C. S. They compete up to twenty-four. Candidates for the India Civil Service originally could compete up to twenty-three. There were no "albuminurics" then. But there were what the aristocracy thinks worse—viz., clever young men of lowly birth who, having time before them to do it in, studied their subjects alone or with such help as they could get, and won the prize. I knew a school "usher" who got one. A chemist's shopman got one. This was intolerable. The high born aristocrats of Haileybury pronounced them "socially unfit" for the service. And as they could not keep them out any other way, the age was lowered. Candidates were to be "over seventeen, under twenty-one." Allowing boys of seventeen to compete did a lot of mischief, and accounts for the "albuminurics," "premature failing of health, exhausted faculties, and shattered nervous systems." But even that did not stop the "socially unfit" men. If allowed to compete up to twenty-one, some could get in. So the age was lowered again, and candidates must now be "over seventeen, under nineteen." There will soon be a far larger number of albuminurics, and more ruined health and shattered systems. Similarly with the engineers and artillery. When the Crimean war broke out, or was breaking out, officers were wanted. Commissions in the "Scientific Branches" were thrown open to public competition. Candidates could compete up to (I think) twenty-two. Young men who meant to live on their pay jumped at this chance. In the very first competition a scholar of my own college succeeded. Some of the "socially unfit" class got in, and they have cut down the age at which candidates can compete for Woolwich to "over sixteen, under eighteen."

The remedy is plain enough. Raise the age. The more you cut down the limit of age, the more cramming, brain-forcing, pressure, &c., and the more ruined health and shattered systems will you have. Not long ago I heard a distinguished M.P., who ought to have known better, say, "the standard should be lowered." You cannot lower the standard. So long as there is any competition, the boys will keep the standard up. Lower the age to twelve, and examine them on the Lord's Prayer, and nothing else, and there is room for good teaching, as well as for cramming and brain-forcing. The cutting down of the

age has done the mischief, and will do more. The more you cut down the age the more severe will be the competition and the worse the breakdowns. We have reached the climax of folly. Boys under fourteen who compete for Public School Scholarships are examined in nine or ten subjects—viz., in English—in (1) religious knowledge, (2) geography, (3) English history, (4) dictation; in languages—in (5) Latin, (6) Greek, (7) French, grammar and translations, and also in (8) Latin prose and (9) Latin verse composition; in mathematics—in (10) arithmetic, (11) algebra, (12) euclid, and lastly, handwriting.

There is room for plenty of breakdowns here. "Religious knowledge" is a middling wide field. You cannot put a quart of beer into a pint pot. You cannot put five years' work into three. Still less can you put fifteen years' work into nine. You cannot make babies do boys' work. And you cannot make boys with immature brains do young men's work without injuring those brains, and, mark, the brains always give way before the physical health suffers. If you put too many irons into the fire of a boy's mind, and keep on blowing at that fire to see whether you can keep all those irons hot, you will very soon burn that fire right away to dust and ashes. This has been done in many cases. The longer you keep the age down, the more there will be.—Your faithful servant,

WALTER WREN.

7 POWIS SQUARE, W., *October* 9, 1883.

EDUCATIONAL OVER-PRESSURE.

(*The Morning Post*, *Friday*, *October* 12, 1883.)

THERE is evidently a good time in store for the spectacle makers in this country, for we have firmly determined to follow the example of Germany, and introduce short-sightedness on a large scale amongst our children. We have decided in favour of mental muddle as against clear vision; and, by means of excessive bookwork in schools, and the severe strain on the muscles of accommodation and the increased tension of the eyeball thereby occasioned, we are already reaping a rich harvest of myopia. It is, of course, difficult for modern ophthalmic surgeons accurately to compare their results with those of their predecessors, who were unprovided with the delicate tests now in use for the detection of errors of sight; but the conclusions they have arrived at cannot, alas! be shaken by the supposition that they are merely bringing to light defects which formerly escaped detection. The present number of grave cases of failure of vision, such as must at any period have secured recognition, is vastly in excess of anything that we find recorded by the authorities of past times, while the multiplication of minor visual impairments is going on under the immediate observa-

tion of living authorities in a manner that admits of no dispute. All English ophthalmologists are agreed that myopia is becoming daily more frequent amongst us ; and Mr Badderch Hewetson and Mr Edgar Browne made it abundantly clear, at the meeting of the Social Science Association at Huddersfield on the 4th inst., that this increased prevalence of myopia is attributable to school-work and over-employment of the eyes on print by children and young persons. The strain of the eyes in reading and fine sewing required of children now to bring them up to the standards which they have to pass results in deformity of these organs, which is more especially apt to occur when there is an inherited tendency to it, where general bodily nutrition is faulty, or where the construction of the school furniture and distribution of the light are faulty. Now these facts as to the spread of short-sightedness amongst the young are alone sufficient to prove that educational overpressure exists, and in view of them it is in vain for members and officials of school boards, who seem all to assume a pedagogic infallibility of tone, to asseverate that the present system is doing no harm, and that the doctors are simply foolish alarmists because they suggest that it is. If education, as now conducted, is causing wholesale short-sightedness, it ought to be overhauled and amended without delay, for, in homely phrase, "the game is not worth the candle," and an elementary knowledge of reading, writing, and arithmetic is dearly purchased by the partial blocking up of one of the great gateways of knowledge, which ought to remain the principal inlet of edification and delight all through life. But these defects of vision which have been alluded to do not exhaust the indictment against education in these days. Worse remains behind. The children whose eyes fail them, and who go on groping over their relentless task in dimness and confusion, complain of headaches, and hundreds of other children whose sight remains good also experience frequent pains in the forehead or vertex. In a certain proportion of these cases the headaches are relieved by the use of appropriate glasses, but in a large number they persist in spite of all ophthalmological efforts, and are shown to depend on a state of irritation of the brain. And it is scarcely to be wondered at that the brain should suffer from processes which leave their pernicious impress on the eye. The eye is a delicate organ, but, compared with the brain, it is what a ship's cable is to a cobweb, and it is certain that any operations in which they are both engaged that are detrimental to the one will be tenfold more detrimental to the other. We really wish that our educationalists, who habitually talk of the brain as if it were a hard and stony structure that will stand any amount of chiselling and polishing, could see a microscopic section of a shred of it. Looking at a group of its starry cells, with their innumerable branches

lying in their neuroglia, "like a swarm of fire-flies tangled in a silver braid," tracing out its intricate conduits and interlacing strands, learning that this exquisite complexity of tissue when alive is of the consistence of red-currant jelly, and that the "living splendour" with which it is "burnished"—its functional activity—is something as impalpable as the bloom on a ripe plum, which can be brushed off with a touch, and can never be reproduced, they would be more chary thereafter in imposing burdens on it, and in wearing it out prematurely by vexing toil. They would realise that if educational over-pressure impairs the power of the eye and alters its shape, it is likely to induce still more serious consequences in that supreme centre of which the eye is but the minister. And the real truth would seem to be that excessive application to study in early years does set up a sort of intellectual short-sightedness, analogous to visual short-sightedness, but much more difficult to discover and measure. We know that, in extreme cases, hopeless imbecility has been induced by the ruthless brain-forcing of children; and we are entitled to infer that in a much larger number of cases artificial stupidity or a blunting of the fine edge of talent has followed it in those who have schooled "not wisely, but too well." The zealous teacher, with an eye to payment by results, gets results where he should only aim at preliminaries, and finishes up at twelve the evolution of a mind that ought to have gone on till middle life. The school headaches which we have adverted to, and which are attracting anxious attention in Germany, are very significant of hidden mischief and of the risks we are running. Headaches used to be utterly unknown in children in this country, except as a premonitory of acute hydrocephalus or as a symptomatic of organic disease of the brain; and now they are of the commonest occurrence amongst town children, many of whom bring them home with them from school every day, while others suffer from them now and again, or when the home work has been exceptionally heavy. But these school headaches betoken an irritated condition of the cerebrum and its membranes, and that they do so is shown by the fact that they occasionally run on into tubercular meningitis. Even, however, when they do not overstep the boundary of common headache, they are full of danger and well calculated to excite forebodings, for the young brain cannot be irritated with impunity, and the headachy child is only too likely to grow up into the dissolute or insane man or the hysterical woman. And not less significant than the school headaches of some children in these days are the school twitchings of others. Grimacings, startings, and choreic movements of one kind or another are prevalent amongst school children of the more affluent classes, and particularly amongst girls, to an extent that could not be

surmised by those who had not made observations on the subject, and that is ominous of disaster. Medical men are, and ever have been, the consistent advocates of education. None knew so well as they the hygienic value of training and development of knowledge, intellectual resources, and self-control. But what they desire is education in its larger sense and not mere schooling. Without under estimating the utility of the schoolmaster, it must be maintained that the least important part of education is that which is obtained under his auspices. He cultivates a corner of human life, and makes it yield useful produce; but its wide expanse teems with luxuriant and varied growth that he has never evoked, but that he may do much to blight and stunt. All nature—sky, earth, flood, field, and flower—all the forces of the universe—the stars in their courses, the summer lightning, the winter's frost, the dancing atoms, the mysteries of hate and love—are ceaselessly busy in teaching the child; and shall we allow a dull man with a ferule in his hand to take the credit of the result? If we do, and, accepting his exaggerated notions of his own mission, permit him to encroach too largely on the domain of the primordial teachers, pinning infants to benches when they should be roaming free, stuffing them with grammar when they should be quaffing sunshine, we, or those who come after us, will bitterly repent it. We shall become an island full of round-backed, blear-eyed bookworms, poor of heart and small of soul, instead of a nation of men and women strong of limb, graceful in movement, nimble-handed, quick-sighted, clear-headed, tender, and true—a nation such as we should all wish the English to become. The penalties of educational over-pressure of every kind fall much more heavily on the children in urban than in rural districts. Their nervous systems are more unstable to begin with, and they lack the benefit of those mighty correctives—fresh air, sunlight, and freedom—which country children enjoy. But on children of all classes the rage for precocity which animates those who have the regulation of educational methods is telling more or less. The screw is applied too severely, and it is applied far too fast. It should have been remembered that the great mass of children gathered or driven into board schools have no inherited aptitude for learning, and can only crawl painfully along the path that better-born children tread lightly. If it takes three generations to make a gentleman, it takes at least half a dozen to make a scholar; and to force sickly and underfed children, handicapped by a load of inherited pathological tendencies, to keep pace with the strong, the well-nourished, the soundly constituted, is both cruel and wasteful. School boards had better rouse themselves to a sense of the true situation at once; if they do not, they will be awakened to it by the voice of the country in somewhat peremptory and ungracious tones before long.—*Medical Times.*

PHYSICAL QUALIFICATIONS OF CIVIL SERVANTS.

From "Madras Weekly Mail," 19th Dec. 1883.

A Bombay contemporary has found the following despatch, dated 8th August 1882, from Bombay Government to the Secretary of State for India, in the last report of Her Majesty's Civil Service Commissioners:—

My Lord Marquis,—We have the honour to acknowledge the receipt of your Lordship's public despatch No. 4, dated 27th April 1882, in paragraph four of which your Lordship desires, with reference to the observations made in our political letter No. 5, dated 31st January last, on the importance of constitutional robustness in the case of young men selected for the Civil Service, to be furnished with full particulars respecting the cases to which those observations relate, including the date of arrival in India.

In reply, we have the honour of forwarding the accompanying list, furnishing, as fully as we can, the information called for by your Lordship, and to state that in our opinion the list shews that too many gentlemen have been sent out who were not sufficiently robust to stand the work, and that, considering the great advantages of the Civil Service, Government have a right to expect that the candidates possess the physical strength without which they cannot efficiently perform their duties.

We beg to add that of three covenanted civil servants lately transferred to this presidency to meet a deficiency of civil officers, one, Mr ———, immediately on his transfer, applied for the full amount of privilege leave to which he was entitled, and supported his application by a medical certificate to the effect that he was "invariably suffering from affections of the liver, stomach," &c., and that his chief complaint at the time was "sleeplessness, violent headache, incapacity for work, great nervousness and general weakness." He was also certified by the head of his department in the Punjab to have "frequently been in ill-health."

We take this opportunity to state, for your Lordship's information, that instances have come to our knowledge of covenanted civil servants being quite unable to ride, though they must have, before they came out to India, furnished certificates of their having undergone a course of instruction in equitation. We have recently ordered such civilians to attend a course of instruction in riding schools, to the detriment of their proper duties. We beg leave, therefore, to suggest the expediency of certificates of equitation from responsible persons being insisted on in future in the case of civilians allotted to this presidency, before they are sent out to India.

THIRD ANNUAL REPORT

OF THE

EDINBURGH HEALTH SOCIETY,

SUBMITTED TO THE MEETING OF MEMBERS ON SATURDAY, THE 8TH MARCH 1884.

IN presenting their Third Annual Report to the Members of the Society, the Committee have pleasure in stating that the Course of Lectures delivered during the past winter has been one of unusual interest. It was opened on the 17th November with an address on "Civic Sanitation" by Professor Chiene, which abounded in excellent advice to, and trenchant though kindly criticism of, our City Sanitary Authorities. The Lecturer at the same time reminded his audience that it is through reiterated *individual* action and expression of opinion on these matters that Sanitary Reforms are achieved; and that one of the advantages of such a Society as this is the stimulus it gives to the creation and expression of such public opinion. His remarks as to the necessity of Edinburgh placing itself under the jurisdiction of the Lord Advocate's new Burgh Police and Health Act, which it is expected may become law this Session of Parliament, are not likely to be forgotten by the Community. Before passing from Professor Chiene's lecture, the Committee beg also to say

they have learned with much pleasure that arrangements for carrying out his suggestion as to the establishment of a "City Ambulance" in Edinburgh are already far advanced, and the suggestion promises very soon to become an accomplished fact. The public of Edinburgh certainly owe much to Professor Chiene for his services in this matter.

Professor Chiene's lecture was followed by a long and interesting one by Dr Andrew Smart, entitled "The Effects of Unhealthy Occupations," being a continuation of his lecture on "Preventible Diseases" in the first series of Edinburgh Health Lectures. Next came Dr Cathcart's lecture on "Physical Exercises," in supplement to his address on that subject in 1882. Then two exceedingly practical and popular lectures on "Healthy Homes" were given by Dr Stevenson Macadam. The Committee feel that special thanks are due to him for the admirable and costly series of experiments with which these lectures were illustrated. The first lecture in 1884 was that on "Hands and Feet," by Professor Turner, which was highly appreciated; and this was followed by the two lively and suggestive addresses given by Mr Hely H. Almond of Loretto, on "The Difficulties of Health Reformers." Dr Clouston's thoughtful and important lecture on "The Development of a Child" brought the series to a close. The Committee have to thank all these gentlemen most heartily for their kind services to the Society.

The lectures are now all published under the auspices of the Society (with the exception of the second), and it is to be hoped the Members of the Society will recommend all their friends to buy them, and *read* them. The Society's publications have now a very wide circulation, no fewer than 444,000 separate lectures having been sold since its establishment in 1881. It may here be stated that the publishers have made arrangements for the exhibition and sale of the Edinburgh

Health Lectures at the International Health Exhibition to be held in London this year.

The Committee beg also to report that their Secretary has, on application, given information and suggestions in connection with the work of this Society, which have assisted in successfully promoting a series of Health Lectures in Birmingham and other places.

The number of members enrolled to the Society during the last year has been largely in excess of that of the preceding winter, though still not up to the figure of 1882. From the Treasurer's statement for the year, it will be seen that 603 Members have been enrolled, as compared with 184 and 637 during the two preceding years respectively. Though this is satisfactory so far, the Committee cannot feel that the number is as large as it should and might be, and they would again urge all Members to get as many of their friends as possible to join the Society. The Committee would remind the Public that they are anxious if possible to acquire sufficient money to enable them by-and-by to establish a good Gymnasium or Recreation Hall in Edinburgh, and they look to the Members of the Society to provide the funds for this. It must also be borne in mind that unless the Membership is maintained so as to give evidence of the Society's importance, the Committee will have hesitation in asking gentlemen to come forward as Lecturers. Here again, therefore, it is seen that the future of the Society is to a great extent in the hands of the Members themselves. The Committee have pleasure in reporting that this year the Right Honourables the Earl of Dalhousie, Lord Reay, and Lord Balfour of Burleigh, have become Life Members of the Society: the first named nobleman having also promised an Annual Subscription of £2, 2s.

Councillor Cox retired from the Treasurership of the Society

last Summer, and Mr Colin M'Cuaig, C.A., has since kindly and successfully undertaken the duties of that office. The Rev. Dr Cazenove and the Rev. James Barclay were elected Members of Committee at last Annual Meeting, but the former was unable from pressure of other duties to accept office, and the latter left Edinburgh for Canada soon after his appointment. In these circumstances the Committee considered themselves fortunate in securing the services of Councillor Cox and the Rev. C. J. Ridgeway to fill the two vacancies, and they trust the Society will now confirm these elections. The following five Members of Committee now fall to retire in accordance with the rules, viz. :— Dr Russell, Mr Thom, Mrs Trayner, Miss Guthrie Wright, and Miss Stodart. The three ladies offer themselves for re-election, and in room of the other two retiring Members, Mr J. Smith Clark, S.S.C., and Mr John Cubie, Cabinetmaker, are recommended for election to the Committee.

Reported on behalf of the Committee by

THOS. ANNANDALE, *Chairman.*
WALTER A. SMITH, *Hon. Secretary.*

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